Carpe Diem Genetics — Study Bank

ANSWER & EXPLANATION UNDER EVERY QUESTION · BIOL 153 · INTRODUCTORY/MEDICAL GENETICS

810 questions · Modules 1–9 + Practice Paper · Devil 201 · Easy 81 · Hard 324 · Medium 204

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Totals: 810 questions — Devil 201 · Easy 81 · Hard 324 · Medium 204.

Module 1: Early ideas, Mendel and monohybrid crosses — 70 questions

1. Early ideas of heredity

Codex, slide 15 · Early ideas of heredity · Easy

1. Which scientist does the lecture credit with proposing pangenesis?

A Charles Darwin

B Jean-Baptiste Lamarck

C August Weismann

D Gregor Mendel

> **Answer 1: A**
>
> Correct. The lecture credits Darwin with pangenesis, in which gemmules from every body part reach the gonads.

Codex, slide 21 · Early ideas of heredity · Easy

2. The "homunculus" belongs to which early theory of heredity?

A Preformation

B Epigenesis

C Pangenesis

D Germplasm theory

> **Answer 2: A**
>
> Correct. Preformationists imagined a miniature man, the homunculus, already formed inside the sperm.

Codex, slide 17 · Early ideas of heredity · Medium

3. A weightlifter's children inherit the large muscles he built through training. Which theory would predict this?

A Epigenesis, because tissues form gradually in the embryo

B Lamarckism, because acquired characteristics can be passed on

C Preformation, because the body is already formed in the gamete

D Germplasm theory, because body changes reach the gametes

> **Answer 3: B**
>
> Correct. Lamarckism holds that traits acquired in a lifetime, such as muscle development, are transmitted to offspring.

Codex, slide 15 · Early ideas of heredity · Medium

4. According to pangenesis, how did information about body parts reach the next generation?

A A miniature copy of each organ was stored in the gamete from the start

B Acquired habits changed the semen directly during mating

C The zygote copied the parents' appearance by gradual differentiation

D Gemmules formed in each body part travelled in the blood to the sperm and eggs

Answer 4: D

Correct. Pangenes or gemmules from each part were carried by blood vessels to the gonads and then inherited.

Codex, slide 24-25 · Early ideas of heredity · Medium

5. What best distinguishes epigenesis from preformation?

A In epigenesis the gamete holds a miniature body, while in preformation the body forms by gradual change

B Epigenesis claims acquired traits are inherited, while preformation denies that traits can be passed on

C In epigenesis tissues form gradually by differentiation; in preformation the body just grows

D Epigenesis requires gemmules in the blood, while preformation requires no transport of material

Answer 5: C

Correct. Epigenesis sees development as differentiation as well as growth, whereas preformation treats it as growth of a ready-made miniature.

Codex, slide 19-24 · Early ideas of heredity · Medium

6. Which pairing of scientist and idea is correct?

A Jan Swammerdam: epigenesis, the gradual formation of the body

B August Weismann: the germplasm theory, a challenge to pangenesis

C Kasper Wolff: pangenesis, the gemmules carried in the blood

D Jean-Baptiste Lamarck: preformation, the miniature body in the gamete

Answer 6: B

Correct. Weismann proposed germplasm theory as the first serious challenge to pangenesis.

Codex, slide 23 · Early ideas of heredity · Medium

7. Spermatists and ovists were both preformationists. What did they disagree about?

A Whether the miniature individual was in the sperm or in the egg

B Whether development involves any growth at all

C Whether acquired traits are passed on to offspring

D Whether gemmules travel in the blood to the gonads

Answer 7: A

Correct. Spermatists placed the preformed individual in the sperm and ovists placed it in the egg.

Codex, slide 17 · Early ideas of heredity · Medium

8. In the lecture's account of Lamarckism, how could an athlete's muscle development be passed to his children?

A Semen formed throughout the body would reflect the modification

B Gemmules would be copied from a miniature body already in the sperm

C The zygote would change gradually through differentiation and growth

D A separate germ line would record the muscle change

Answer 8: A

Correct. The lecture says such changes could be transmitted if semen formed throughout the body reflected them.

Codex, slide 25 · Early ideas of heredity · Hard

9. Which observation about chick embryos supports epigenesis over preformation?

A A miniature chick visible inside the egg before any development

B Gemmules from the hen's body travelling in the blood to the egg

C Chicks inheriting the injuries or habits of their parents

D A gradual change from egg to foetus to adult, not a ready-made miniature

Answer 9: D

Correct. Gradual change in the chick is what epigenesis predicts.

Codex, slides 15, 21, 25 · Early ideas of heredity · Hard

10. Which of the following statements about early theories of heredity are correct?
1. Pangenesis proposed that gemmules from each body part reach the gametes.
2. Preformation held that a miniature individual already exists in the gamete.
3. Epigenesis held that the gametes contain a small version of the body.

A 1, 2 and 3

B 2 and 3 only

C 1 and 2 only

D 1 and 3 only

Answer 10: C

Correct. Statements 1 and 2 describe pangenesis and preformation accurately; statement 3 is false.

Codex, slides 15, 18, 21 · Early ideas of heredity · Hard

11. Match each statement to the theory it illustrates.
(i) An acquired scar is passed on to offspring.
(ii) A tiny man is already present in the sperm.
(iii) Gemmules from every organ gather in the gonads.

A (i) Pangenesis; (ii) preformation; (iii) Lamarckism

B (i) Lamarckism; (ii) epigenesis; (iii) pangenesis

C (i) Preformation; (ii) Lamarckism; (iii) epigenesis

D (i) Lamarckism; (ii) preformation; (iii) pangenesis

Answer 11: D

Correct. Inheritance of acquired scars is Lamarckism, a miniature man is preformation, and gemmules in the gonads are pangenesis.

Codex, slide 26 · Early ideas of heredity · Hard

12. Which statement best matches the lecture's conclusion about heredity?

A Parents transmit a ready-made miniature version of the offspring

B Parents transmit acquired characteristics through gemmules in the blood

C Parents pass on DNA instructions that act with the environment

D Offspring development is determined by the environment alone, not by genes

> **Answer 12: C**
>
> Correct. The conclusion is that genetic information in DNA, interacting with the environment, directs the organism's development.

Codex, slide 19 · Early ideas of heredity · Hard

13. Which idea did the germplasm theory seriously challenge, and who proposed it?

A Epigenesis, challenged by August Weismann

B Pangenesis, challenged by August Weismann

C Pangenesis, challenged by Charles Darwin

D Preformation, challenged by Charles Darwin

> **Answer 13: B**
>
> Correct. Weismann's germplasm theory was the first serious challenge to pangenesis.

Codex, slide 21-24 · Early ideas of heredity · Hard

14. A microscopist claims to see a tiny man inside a sperm cell. Which theory does this support, and what did epigenesis say instead?

A Pangenesis; epigenesis said gemmules travel in the blood

B Lamarckism; epigenesis said acquired traits are inherited

C Preformation; epigenesis said the gamete holds a miniature body

D Preformation; epigenesis said sex cells contain nothing resembling the body

> **Answer 14: D**
>
> Correct. The homunculus supported preformation, whereas epigenesis said the sex cells are largely homogeneous matter.

Codex, slide 15-18 · Early ideas of heredity · Hard

15. What links pangenesis to the Lamarckian example of an inherited scar in the lecture?

A Both say a ready-made miniature organism exists in the gamete

B Both say the gametes contain nothing resembling the adult body

C Gemmules from a modified body part would carry the change to the gonads

D Both say development is differentiation as well as simple growth

> **Answer 15: C**
>
> Correct. Scars or tattoos were said to be inherited as scar or tattoo pangenes.

Codex, slide 24-26 · Early ideas of heredity · Devil

16. A student argues: "Epigenesis beat preformation, so the zygote carries no hereditary information at all." Which response is most accurate?

A Right: epigenesis says gametes contain no information, so development depends on the environment alone

B Wrong: the body is not preformed, but the zygote carries DNA information that, with the environment, directs development

C Wrong: the zygote does contain a miniature organism, because preformation was shown to be correct

D Right: only the parents' acquired characteristics direct development, as Lamarckism taught

> **Answer 16: B**
>
> Correct. The lecture concludes that parents pass on instructions (information in DNA) that interact with the environment, even though the organism itself is not preformed.

2. Mendel and terminology

Codex, slide 30 · Mendel and terminology · Easy

17. What is the scientific name of the plant Mendel used?

A Pisum sativum

B Zea mays

C Oryza sativa

D Arabidopsis thaliana

> **Answer 17: A**
>
> Correct. Mendel worked with the common garden pea, Pisum sativum.

Codex, slide 29 · Mendel and terminology · Easy

18. How does the lecture describe Mendel?

A An Austrian monk at St Thomas monastery in Brünn

B A Dutch microscopist who studied sperm cells in Delft

C An English naturalist who travelled on a long research voyage

D A French army officer who bred farm animals for a living

> **Answer 18: A**
>
> Correct. The lecture describes Mendel as an Austrian monk in Brünn who studied botany and mathematics.

Codex, slide 44 · Mendel and terminology · Easy

19. A pea plant has the genotype Dd. What is it called?

A Homozygous dominant

B Homozygous recessive

C Hemizygous

D Heterozygous

Answer 19: D

Correct. Two different alleles (D and d) make the plant heterozygous.

Codex, slide 36 · Mendel and terminology · Easy

20. The position of a gene on a chromosome is called its:

A Allele

B Locus

C Genotype

D Phenotype

Answer 20: B

Correct. The lecture defines the locus as the location of a gene on a chromosome.

Codex, slide 37 · Mendel and terminology · Medium

21. Which statement best describes an allele?

A The section of chromosome where a gene is located on the chromosome

B The visible expression of an inherited trait in an organism

C An alternative form of a gene, one on each homologous chromosome

D A change in the number of chromosomes present in a cell

Answer 21: C

Correct. Alleles are different versions of the same gene, one on each homologous chromosome.

Codex, slide 31 · Mendel and terminology · Medium

22. Why were pea flowers convenient for Mendel's work with self-fertilization?

A They are perfect flowers, so they can self-fertilize

B They have male and female parts on separate plants entirely

C They cannot be fertilized by pollen from any other plant

D They produce seeds without any fertilization taking place

Answer 22: A

Correct. Having both parts in one flower lets the ovule be fertilized by pollen from the same flower.

Codex, slide 34-35 · Mendel and terminology · Medium

23. Which trait would be least suitable for Mendel's method of studying simple on-or-off traits?

A Flower colour, which is purple or white

B Seed texture, which is round or wrinkled

C Seed weight, which is controlled by many genes

D Plant height, which is tall or dwarf

Answer 23: C

Correct. Seed weight is a quantitative trait controlled by multiple genes and varies continuously.

Codex, slide 39 · Mendel and terminology · Medium

24. Besides studying one character at a time, what made Mendel's approach distinctive?

A He used microscopes to look for gemmules in the pollen

B He counted progeny of each kind to test the proportions

C He judged the overall resemblance of whole plants to parents

D He relied on natural pollination without controlled crosses

> **Answer 24: B**
>
> Correct. His quantitative approach, counting offspring of each kind, revealed constant proportions.

Codex, slide 42 · Mendel and terminology · Medium

25. In Mendel's tall × dwarf experiment the F2 contained 787 tall and 277 dwarf plants. The ratio is closest to:

A 1:1

B 2:1

C 4:1

D 3:1

> **Answer 25: D**
>
> Correct. 787 divided by 277 is about 2.84, which is close to 3:1.

Codex, slide 43 · Mendel and terminology · Medium

26. Why are all the F1 plants of a tall × dwarf cross tall?

A The dwarf allele is lost during fertilization of the zygote

B Each F1 plant receives two tall alleles from its parents

C Dwarfness is controlled by many genes acting together

D Each F1 plant is Dd, and the tall allele is dominant

> **Answer 26: D**
>
> Correct. All F1 plants carry one tall and one dwarf allele, and dominance makes them tall.

Codex, slide 32 · Mendel and terminology · Medium

27. In Mendel's tall × dwarf cross, which statement uses the lecture's terms correctly?

A Height is the character; tall is one trait of it

B Tall is the character; height is one trait of it

C Height and tall are both alleles of the same gene

D Height is the genotype; tall is the gene's locus

> **Answer 27: A**
>
> Correct. A character is a feature that varies, and each variant of it is a trait.

Codex, slide 28, 40 · Mendel and terminology · Medium

28. In the tall × dwarf experiment, what does the P generation consist of?

A The first generation of offspring

B The original tall and dwarf parent plants

C The hybrid plants that were self-fertilized

D The offspring of the F1 plants

> **Answer 28: B**
>
> Correct. P stands for parental: the plants crossed at the start.

Codex, slide 40 · Mendel and terminology · Hard

29. Mendel removed the anthers from the "test" flowers before crossing. What would happen if he had not?

A The flowers would produce no seeds at all after the cross

B All offspring would automatically be tall, whatever the pollen

C Some seeds would come from self-pollination, mixing the cross

D The pollen from the other parent could not fertilize the ovules

> **Answer 29: C**
>
> Correct. Removing anthers prevents self-fertilization so that only the chosen pollen fertilizes the ovules.

Codex, slide 44 · Mendel and terminology · Hard

30. A plant looks like the dominant type. Could it still carry a recessive allele, and why?

A No: a recessive allele always shows whenever it is present

B No: dominant-looking plants have only dominant alleles at that gene

C Yes: but only if the plant is also dwarf and homozygous

D Yes: the dominant allele determines the trait in the heterozygote

> **Answer 30: D**
>
> Correct. Dd plants look dominant because the dominant allele masks the recessive one.

Codex, slides 45-46 · Mendel and terminology · Hard

31. Which statements about genotype and phenotype are correct?
1. A phenotype is any measurable characteristic of an organism.
2. A genotype is the set of alleles an individual possesses.
3. A phenotype is fixed by the genotype alone, whatever the environment.

A 1, 2 and 3

B 1 and 2 only

C 2 and 3 only

D 1 and 3 only

> **Answer 31: B**
>
> Correct. Statements 1 and 2 match the lecture; statement 3 is false since gene products act in a given environment.

Codex, slide 40-43 · Mendel and terminology · Hard

32. Which genotypes represent the P generation and the F1 in Mendel's tall × dwarf experiment?

A P: Dd × Dd; F1: DD

B P: DD × Dd; F1: dd

C P: DD × dd; F1: Dd

D P: dd × dd; F1: Dd

> **Answer 32: C**
>
> Correct. Pure tall and pure dwarf parents give Dd hybrids.

Codex, slide 44 · Mendel and terminology · Hard

33. Which statement about dominance is correct according to the lecture?

A Dominance means an allele is more common in the whole population

B Dominance applies to how a trait appears in heterozygotes

C Dominance applies only to homozygous individuals, never to hybrids

D Dominance means one allele permanently changes the other allele

> **Answer 33: B**
>
> Correct. Dominance is seen in the heterozygote, where one allele hides the other.

Codex, slides 32, 39-40 · Mendel and terminology · Hard

34. Which statements about Mendel's method are correct?
1. He counted the progeny of each kind.
2. He studied one character at a time.
3. He judged the whole plant for overall resemblance.

A 1, 2 and 3

B 1 and 2 only

C 2 and 3 only

D 1 and 3 only

> **Answer 34: B**
>
> Correct. He counted progeny and followed one character at a time, not whole-plant resemblance.

Codex, slide 34-35 · Mendel and terminology · Devil

35. A farmer crosses two pea lines that differ in seed weight. The F2 plants show a smooth range of weights, not distinct classes. What is the best explanation?

A Seed weight is a quantitative trait under many genes

B The law of segregation does not apply to pea plants at all

C The F1 plants must have been tall rather than dwarf

D Dominance is complete, so only two classes should appear

> **Answer 35: A**
>
> Correct. Quantitative traits such as seed weight depend on many genes, so they do not give Mendel's simple classes.

Codex, slide 43-44, 57 · Mendel and terminology · Devil

36. Why can a recessive allele persist for many generations without showing?

A It is masked in heterozygotes and shows only in homozygous recessives

B It is destroyed in each new generation of offspring plants

C It changes into the dominant allele after each new cross

D It is passed on only through the sperm cells, never eggs

> **Answer 36: A**
>
> Correct. Carriers (Dd) hide the allele until two copies meet.

3. Segregation (monohybrid cross)

Codex, slide 49 · Segregation (monohybrid cross) · Easy

37. What did Mendel call the rule that the two factors for a trait separate into different gametes?

A The principle of independent assortment

B The principle of dominance only

C The principle (law) of segregation

D The principle of blending inheritance

> **Answer 37: C**
>
> Correct. Fertilization gives two factors per trait, and they separate into different gametes: the rule of segregation.

Codex, slide 50 · Segregation (monohybrid cross) · Medium

38. What does "purity of gametes" mean in Mendel's principle of segregation?

A Each gamete carries both alleles of every pair together

B Gametes are completely free from every kind of mutation

C Gametes come only from parents that are homozygous

D Each gamete carries a single allele of each pair

> **Answer 38: D**
>
> Correct. Segregation separates the paired alleles so each gamete carries one of them.

Codex, slide 55 · Segregation (monohybrid cross) · Medium

39. A heterozygous Dd plant produces which gametes?

A All Dd

B Half D and half d

C All D

D Three D for every d

> **Answer 39: B**
>
> Correct. Segregation gives D and d gametes in equal numbers.

Codex, slide 55 · Segregation (monohybrid cross) · Hard

40. Why can the separation of alleles be detected only in a heterozygous parent?

A Only Dd plants undergo meiosis to produce gametes

B Only Dd makes two gamete types; DD and dd make one

C Only Dd plants carry a dominant allele for the trait

D DD and dd plants cannot form functional gametes at all

> **Answer 40: B**
>
> Correct. A heterozygote gives D and d gametes, so the separation shows up in its offspring.

Codex, slide 42-44 · Segregation (monohybrid cross) · Hard

41. Two Dd plants are crossed. Which genotype ratio is expected in the offspring?

A 3 DD : 1 dd

B 1 DD : 1 Dd : 1 dd

C 1 DD : 2 Dd : 1 dd

D 1 Dd : 1 dd

> **Answer 41: C**
>
> Correct. Combining D and d gametes from each parent gives DD, Dd, Dd and dd.

Codex, slide 42 · Segregation (monohybrid cross) · Hard

42. Of 400 offspring from a Dd × Dd cross, how many are expected to be dwarf (dd) and how many heterozygous (Dd)?

A 100 dwarf and 100 heterozygous

B 200 dwarf and 100 heterozygous

C 300 dwarf and 100 heterozygous

D 100 dwarf and 200 heterozygous

> **Answer 42: D**
>
> Correct. The genotypic ratio is 1:2:1, so dd is a quarter (100) and Dd is a half (200).

Codex, slide 55-57 · Segregation (monohybrid cross) · Hard

43. Why does the dwarf phenotype reappear in the F2 of a Dd × Dd cross?

A Each Dd parent makes d gametes, so two d gametes can form dd

B The tall allele mutates to the dwarf allele in the F2 plants

C New dwarf alleles are created during fertilization itself

D Only the sperm cells carry the dwarf allele forward

> **Answer 43: A**
>
> Correct. Segregation puts d in half the gametes, so dd can form.

Codex, slides 43-44, 57 · Segregation (monohybrid cross) · Hard

44. Which statements about the F1 (Dd) plants of a tall × dwarf cross are correct?

1. The F1 is hybrid for only one character.

2. Its tall appearance is due to a dominant allele.

3. It will breed true for tallness when self-fertilized.

A 1 and 2 only

B 1, 2 and 3

C 2 and 3 only

D 1 and 3 only

> **Answer 44: A**
>
> Correct. The F1 is a monohybrid and its tallness is due to the dominant allele; it does not breed true.

Codex, slide 42, 101-102 · Segregation (monohybrid cross) · Hard

45. Mendel's F2 of 787 tall and 277 dwarf plants gives 2.84:1, not exactly 3:1. What is the best explanation?

A Dwarf is partly dominant over tall in the heterozygote

B Segregation failed to occur in some of the plants

C Chance deviation, which is expected in a finite sample

D The tall allele is actually recessive to dwarf

> **Answer 45: C**
>
> Correct. Small departures from a predicted ratio are expected from chance deviation.

Codex, slide 42 · Segregation (monohybrid cross) · Hard

46. If the 1064 F2 plants had followed a 3:1 ratio exactly, how many would be tall?

A 798

B 787

C 266

D 532

> **Answer 46: A**
>
> Correct. Three quarters of 1064 is 798.

Codex, slide 42-44 · Segregation (monohybrid cross) · Hard

47. Of 1200 F2 plants from a Dd × Dd cross, how many are expected to be homozygous dominant (DD)?

A 600

B 300

C 900

D 400

> **Answer 47: B**
>
> Correct. DD is one quarter of the F2, so 300 of 1200.

Codex, slide 43 · Segregation (monohybrid cross) · Hard

48. Why do all the F1 plants look like the tall parent rather than a blend of tall and dwarf?

A The dwarf allele is destroyed in the zygote

B The tall and dwarf alleles blend into one intermediate allele

C Dd plants contain two tall alleles

D The tall allele is dominant, so Dd plants express tallness

> **Answer 48: D**
>
> Correct. Dominance means the heterozygote shows the tall trait.

Codex, slide 42-44, 57 · Segregation (monohybrid cross) · Hard

49. Which F2 plants breed true for tallness when self-fertilized?

A Only the DD plants, one quarter of the F2

B All tall F2 plants, whatever their genotype

C Only the Dd plants, one half of the F2

D None of the F2 plants, because all carry a d allele

> **Answer 49: A**
>
> Correct. DD plants give only DD offspring; Dd plants also give dwarf offspring.

Codex, slide 42 · Segregation (monohybrid cross) · Hard

50. In a Dd × Dd cross with 40 offspring, which result is most consistent with a 3:1 ratio?

A 40 tall and 0 dwarf

B 20 tall and 20 dwarf

C 10 tall and 30 dwarf

D 29 tall and 11 dwarf

> **Answer 50: D**
>
> Correct. A 3:1 ratio expects 30 tall and 10 dwarf, and 29:11 is very close.

Codex, slide 42-44 · Segregation (monohybrid cross) · Devil

51. A tall F2 plant from a Dd × Dd cross is chosen at random. What is the probability that it is heterozygous?

A 1/2

B 2/3

C 1/3

D 3/4

> **Answer 51: B**
>
> Correct. Tall plants are 1/4 DD plus 2/4 Dd, so 2 of every 3 tall plants are Dd.

Codex, slide 101-103 · Segregation (monohybrid cross) · Devil

52. A Dd × Dd cross yields only 6 offspring, and all are tall. What is the best interpretation?

A Both parents must actually be homozygous dominant DD

B The 3:1 ratio is wrong and dominance must be absent here

C Chance deviation is large in small samples; 3:1 stands

D Segregation failed to occur in these two parents

> **Answer 52: C**
>
> Correct. With so few offspring, chance deviation can easily hide the expected dwarf plants.

Codex, slide 42-43 · Segregation (monohybrid cross) · Devil

53. Which observation most directly shows that the tall F1 hybrids carry the dwarf allele?

A The F1 are all tall

B Dwarf plants reappear in the F2

C The F1 look the same as the tall parent

D The F1 produce many seeds

> **Answer 53: B**
>
> Correct. Dwarf offspring from tall hybrids show the allele was present and hidden.

Codex, slide 42-44 · Segregation (monohybrid cross) · Devil

54. Out of 120 tall F2 plants from a Dd × Dd cross, how many are expected to be heterozygous?

A 40

B 60

C 80

D 90

> **Answer 54: C**
>
> Correct. Two thirds of the tall plants are Dd, so 80 of 120.

Codex, slide 49-50 · Segregation (monohybrid cross) · Devil

55. Which statement about "purity of gametes" in a Dd parent is correct?

A Each gamete is pure for one allele though the parent is heterozygous

B Gametes from a Dd parent are all Dd and carry both alleles

C The D allele is changed to d in half of the gametes made

D Gametes from a Dd parent contain no alleles of this gene

> **Answer 55: A**
>
> Correct. Segregation puts one allele of the pair in each gamete, so gametes are pure for D or d.

Codex, slide 49-50 · Segregation (monohybrid cross) · Devil

56. Which statement fits Mendel's segregation rule for alleles in a hybrid?

A The dominant allele permanently alters the recessive allele

B The alleles fuse in the hybrid and then re-split at random

C The recessive allele is lost from all of the gametes made

D The alleles stay unchanged in the hybrid and separate into gametes

> **Answer 56: D**
>
> Correct. The alleles remain distinct and separate at gamete formation.

Codex, slide 42-44 · Segregation (monohybrid cross) · Devil

57. Two tall plants are crossed and some of the offspring are dwarf. What are the parental genotypes?

A DD and Dd

B Both parents are Dd

C DD and DD

D Dd and dd

> **Answer 57: B**
>
> Correct. Dwarf (dd) offspring need a d allele from each parent, and tall parents must be Dd.

Codex, slide 42-44 · Segregation (monohybrid cross) · Devil

58. The F2 shows 3 tall : 1 dwarf, yet the genotypic ratio is 1:2:1. Why do the two ratios differ?

A DD and Dd look alike through dominance, one phenotype

B Dd plants are dwarf, so they count with the dwarf class

C One genotype class is lost before the plants are counted

D The 3:1 ratio counts the gametes instead of the whole plants

> **Answer 58: A**
>
> Correct. Combining DD and Dd as tall gives 3 tall to 1 dwarf.

Codex, slide 42-44 · Segregation (monohybrid cross) · Devil

59. Which F2 result would most strongly contradict Mendel's segregation rule in a tall × dwarf cross?

A 787 tall and 277 dwarf plants

B About three tall plants for each dwarf plant

C Many intermediate plants and no dwarf plants

D Dwarf plants reappearing in the F2

> **Answer 59: C**
>
> Correct. Intermediate plants with no dwarf reappearance would fit blending, not segregation.

4. Testcross and backcross

Codex, slide 58 · Testcross and backcross · Medium

60. A cross of an organism of unknown genotype to a homozygous recessive organism is called a:

A Backcross

B Reciprocal cross

C Monohybrid cross

D Testcross

> **Answer 60: D**
>
> Correct. The lecture defines a testcross as a cross to a known homozygous recessive.

Codex, slide 56 · Testcross and backcross · Medium

61. An F1 (Dd) plant is crossed back to the dwarf (dd) variety. What offspring ratio is expected?

A 3 tall : 1 dwarf

B All tall

C All dwarf

D 1 tall : 1 dwarf

> **Answer 61: D**
>
> Correct. Dd gives D and d gametes and dd gives only d, so half the offspring are tall and half dwarf.

Codex, slide 61 · Testcross and backcross · Hard

62. What is the key difference between a testcross and a backcross?

A A testcross always uses a homozygous recessive parent, a backcross need not

B A backcross always uses a homozygous recessive parent, a testcross does not

C A testcross uses only the F1, while a backcross uses unrelated plants

D They are identical in every case, with no difference between them

> **Answer 62: A**
>
> Correct. In a testcross the recessive homozygote is always one parent; in a backcross the F1 is crossed to a parent or parental genotype.

Codex, slide 57 · Testcross and backcross · Hard

63. Why can a carrier (Dd) not be recognised by its appearance?

A Carriers have no recessive allele in any of their cells

B Recessive alleles occur only in gametes, never in body cells

C The dominant allele masks the recessive, so Dd looks like DD

D The Dd phenotype is intermediate and cannot be classified

> **Answer 63: C**
>
> Correct. Recessive alleles are expressed only in homozygous dd, so carriers look dominant.

Codex, slide 58 · Testcross and backcross · Hard

64. Why is a homozygous recessive plant used as the tester parent in a testcross?

A It always gives tall offspring, whatever the other parent is

B It makes only d gametes, so offspring reveal the other parent's gametes

C It forces the unknown parent to self-fertilize before crossing

D It changes the alleles of the unknown parent during the cross

> **Answer 64: B**
>
> Correct. Because dd supplies only d gametes, every offspring phenotype reflects the gamete from the unknown parent.

Codex, slide 57 · Testcross and backcross · Hard

65. How can a recessive allele hidden in a tall plant be identified experimentally?

A Measure its height and compare it with the F1 plants' average

B Inspect its pollen for the dwarf allele under a microscope

C Cross the plant to a homozygous recessive; see the offspring

D Remove its anthers and wait for the next growing season

> **Answer 65: C**
>
> Correct. The lecture says carriers are found by crossing them to homozygous recessive individuals.

Codex, slide 58-61 · Testcross and backcross · Devil

66. Crossing an F1 (Dd) plant back to its dwarf (dd) parent is best described as:

A A backcross only, since the dwarf plant is the F1's parent

B A testcross only, since the F1 is unrelated to the dwarf plant

C Neither, since a heterozygous F1 cannot be used in either cross

D Both, since the dwarf plant is a parent and homozygous recessive

> **Answer 66: D**
>
> Correct. The dwarf parent satisfies both definitions.

Codex, slides 57-61 · Testcross and backcross · Devil

67. Classify each cross.
(i) A tall plant of unknown genotype, unrelated to the dwarf plant, × a dwarf (dd) plant.
(ii) An F1 (Dd) plant × its tall (DD) parent.
(iii) An F1 (Dd) plant × its dwarf (dd) parent.

A (i) backcross only; (ii) testcross only; (iii) both a testcross and a backcross

B (i) testcross only; (ii) testcross only; (iii) backcross only

C (i) testcross only; (ii) backcross only; (iii) both a testcross and a backcross

D (i) both a testcross and a backcross; (ii) backcross only; (iii) testcross only

> **Answer 67: C**
>
> Correct. (i) uses a recessive tester, so it is a testcross only; (ii) is a backcross to a dominant parent; (iii) satisfies both definitions.

Codex, slide 57, 101 · Testcross and backcross · Devil

68. A tall plant of unknown genotype is testcrossed and all 30 offspring are tall. What is the most reasonable conclusion?

A The parent is certainly DD, since chance cannot affect 30 offspring

B The parent is very likely DD; a Dd parent would rarely give 30 tall

C The parent is Dd, since all offspring show the dominant trait

D The parent is dd, since the tester it was crossed with was recessive

> **Answer 68: B**
>
> Correct. A Dd parent gives about half dwarf offspring, so 30 tall in a row is very unlikely, though not strictly impossible.

Codex, slide 57-58 · Testcross and backcross · Devil

69. A tall plant has an unknown genotype. Which cross answers the question in one generation, and what outcome indicates Dd?

A Cross it to a dwarf plant; half dwarf offspring indicates Dd

B Cross it to another tall plant; all tall offspring indicates Dd

C Self-fertilize it; all tall offspring would indicate Dd

D Cross it to a dwarf plant; all tall offspring indicates Dd

> **Answer 69: A**
>
> Correct. A dwarf tester (dd) with a Dd parent gives about 1 tall : 1 dwarf.

Codex, slide 55-58 · Testcross and backcross · Devil

70. A dwarf plant is crossed with a tall plant and gives 49 tall and 51 dwarf offspring. Which principle best explains this?

A Independent assortment of two different gene pairs at once

B Segregation: Dd makes D and d gametes equally; dd makes d

C Blending of the tall and dwarf alleles in the hybrid

D Preformation of tall and dwarf offspring in the gametes

> **Answer 70: B**
>
> Correct. A heterozygote crossed with a dwarf gives about 1:1 because of equal D and d gametes.

Module 2: Dihybrid and trihybrid crosses — 70 questions

1. Independent assortment (dihybrid cross)

Codex, slide 65 · Independent assortment (dihybrid cross) · Easy

71. Which statement is Mendel's law of independent assortment?

A Genes for different characters are inherited independently

B The two alleles of a gene separate into different gametes

C Recessive alleles are expressed only when homozygous

D Offspring always resemble the dominant parent in every cross

> **Answer 71: A**
>
> Correct. Different gene pairs assort independently into gametes.

Codex, slide 72 · Independent assortment (dihybrid cross) · Easy

72. How many squares does a Punnett square need for a dihybrid F1 × F1 cross?

A 4

B 8

C 16

D 64

> **Answer 72: C**
>
> Correct. Each F1 plant makes four gamete types, so the square has 4 × 4 = 16 cells.

Codex, slide 64-66 · Independent assortment (dihybrid cross) · Easy

73. What is the F1 genotype of a cross between GGWW and ggww plants?

A GGWW

B ggww

C GgWW

D GgWw

> **Answer 73: D**
>
> Correct. Each parent gives one allele of each pair, so the F1 is heterozygous for both genes.

Codex, slide 66 · Independent assortment (dihybrid cross) · Medium

74. In the cross of round, yellow seeds with wrinkled, green seeds, all the F1 had round, yellow seeds. What does this show?

A Round and yellow are dominant over wrinkled and green

B The wrinkled and green alleles are lost in the F1

C Round and yellow are recessive to wrinkled and green

D The two genes are always inherited together as a unit

> **Answer 74: A**
> Correct. Only the dominant traits show in the F1 hybrids.

Codex, slide 64 · Independent assortment (dihybrid cross) · Medium

75. What does a dihybrid cross consider?

A One trait followed through two generations

B Two traits followed at the same time

C Two plants that share the same genotype

D Three alleles of a single gene at once

> **Answer 75: B**
> Correct. A dihybrid cross follows two traits simultaneously.

Codex, slide 70-71 · Independent assortment (dihybrid cross) · Medium

76. A dihybrid F1 plant is selfed and gives 640 F2 seeds. How many are expected to show both recessive traits?

A 120

B 360

C 40

D 160

> **Answer 76: C**
> Correct. The double recessive class is 1/16 of 640, which is 40.

Codex, slide 70-71 · Independent assortment (dihybrid cross) · Medium

77. From a cross of round, yellow with wrinkled, green plants, 640 F2 seeds are produced. How many are expected to be round and yellow?

A 120

B 40

C 240

D 360

> **Answer 77: D**
> Correct. The 9/16 class of 640 is 360.

Codex, slide 70-71 · Independent assortment (dihybrid cross) · Medium

78. An F2 of 960 seeds follows a 9:3:3:1 ratio. How many are expected to be wrinkled and yellow?

A 180

B 540

C 60

D 360

> **Answer 78: A**
>
> Correct. The 3/16 class of 960 is 180.

Codex, slide 64-66 · Independent assortment (dihybrid cross) · Medium

79. What is the F1 genotype of a cross between AAbb and aaBB plants?

A AABB

B AaBb

C aabb

D AaBB

> **Answer 79: B**
>
> Correct. Each parent contributes one allele of each gene, giving AaBb.

Codex, slide 72 · Independent assortment (dihybrid cross) · Medium

80. Which gametes can a GGww plant make?

A G and w in equal numbers as separate gametes

B GW, Gw, gW and gw

C Gg and Ww

D Only Gw

> **Answer 80: D**
>
> Correct. A plant homozygous for both genes makes one gamete type.

Codex, slide 72-73 · Independent assortment (dihybrid cross) · Medium

81. Why does a GgWw plant make four kinds of gamete?

A Only the dominant alleles of each pair enter the gametes made

B The two genes are always inherited together as one unit

C Each pair separates and either allele can pair with either of the other

D Each gamete carries both alleles of each of the two pairs

> **Answer 81: C**
>
> Correct. Segregation plus independent assortment gives GW, Gw, gW and gw.

Codex, slide 70 · Independent assortment (dihybrid cross) · Medium

82. Which F2 class in the dihybrid seed cross is homozygous recessive for both genes?

A Wrinkled, green (ggww)

B Round, yellow (GGWW)

C Round, green

D Wrinkled, yellow

> **Answer 82: A**
>
> Correct. Only wrinkled green seeds carry two recessive alleles of both genes.

Codex, slide 71 · Independent assortment (dihybrid cross) · Medium

83. Taken alone, each gene pair of a dihybrid cross gives which F2 ratio?

A 9:3:3:1

B 1:2:1

C 3:1

D 1:1

> **Answer 83: C**
>
> Correct. Each pair behaves as a monohybrid cross, and the two 3:1 ratios combine to give 9:3:3:1.

Codex, slide 68-70 · Independent assortment (dihybrid cross) · Hard

84. From 556 F2 seeds the numbers were 315 round yellow, 108 round green, 101 wrinkled yellow and 32 wrinkled green. Which ratio do these closely fit?

A 3:1

B 9:3:3:1

C 1:1:1:1

D 1:2:1

> **Answer 84: B**
>
> Correct. 315:108:101:32 divided by 556 is close to 9/16, 3/16, 3/16 and 1/16.

Codex, slide 70 · Independent assortment (dihybrid cross) · Hard

85. If the 556 F2 seeds follow a 9:3:3:1 ratio exactly, about how many should be round and yellow?

A About 417

B About 104

C About 35

D About 313

> **Answer 85: D**
>
> Correct. 9/16 of 556 is about 313.

Codex, slide 71 · Independent assortment (dihybrid cross) · Hard

86. How does the product rule explain the 9:3:3:1 ratio?

A It adds two 3:1 ratios together to give a 6:2 ratio

B It treats the cross as two independent 3:1 crosses

C It assumes the F1 produces only two kinds of gamete

D It assumes the two genes are always inherited together

> **Answer 86: B**
>
> Correct. Multiplying the probabilities from two independent monohybrid crosses gives 9:3:3:1.

Codex, slide 72-73 · Independent assortment (dihybrid cross) · Hard

87. What does independent assortment predict about the frequencies of the four gamete types made by a GgWw plant?

A GW and gw are the most frequent

B Gametes with two dominant alleles are the most frequent

C They occur in equal numbers, each one quarter

D Only the parental combinations occur

> **Answer 87: C**
>
> Correct. GW, Gw, gW and gw each occur at one quarter.

Codex, slide 72 · Independent assortment (dihybrid cross) · Hard

88. Which gametes can the F1 (GgWw) of a GGWW × ggww cross produce?

A GW, Gw, gW and gw

B GW and gw only

C Gg and Ww only

D GGWW and ggww

> **Answer 88: A**
>
> Correct. Independent assortment gives all four combinations.

Codex, slide 70-73 · Independent assortment (dihybrid cross) · Hard

89. A dihybrid F1 (GgWw) is self-fertilized to give 960 F2 seeds. How many are expected to be GgWw?

A 180

B 120

C 540

D 240

> **Answer 89: D**
>
> Correct. GgWw is 4/16 of the F2, which is 240 seeds.

Codex, slide 72-76 · Independent assortment (dihybrid cross) · Hard

90. Which two F2 classes of a round, yellow × wrinkled, green dihybrid cross are expected in equal numbers?

A Round, green and wrinkled, yellow

B Round, yellow and wrinkled, green

C Round, yellow and round, green

D Wrinkled, green and round, green

> **Answer 90: A**
>
> Correct. Both are 3/16 of the F2.

Codex, slide 76; general · Independent assortment (dihybrid cross) · Hard

91. Which observation in a dihybrid backcross would suggest that the two genes are NOT assorting independently?

A All four classes are found in about equal numbers

B Parental types far outnumber the new combinations

C Each class is close to one quarter of the offspring

D Two classes are missing because of dominance

> **Answer 91: B**
>
> Correct. Independent assortment predicts 1:1:1:1, so a strong excess of parental types is a departure from it.

Codex, slide 76 · Independent assortment (dihybrid cross) · Devil

92. A GgWw plant is testcrossed. The offspring are round yellow 24, round green 26, wrinkled yellow 25 and wrinkled green 25. Which interpretation is best?

A The two genes are tightly linked on one chromosome

B Round and yellow are recessive traits in this plant

C The F1 made four gamete types, about equally often

D The plant was homozygous for both of the genes

> **Answer 92: C**
>
> Correct. A 1:1:1:1 result fits four equally frequent gamete types.

Codex, slide 64-68 · Independent assortment (dihybrid cross) · Devil

93. Round, yellow (GGWW) plants are crossed with wrinkled, green (ggww) plants. Which two F2 phenotypes are new combinations not seen in either parent?

A Round, yellow and wrinkled, green

B Round, yellow and round, green

C Wrinkled, yellow and wrinkled, green

D Round, green and wrinkled, yellow

> **Answer 93: D**
>
> Correct. The parents were round yellow and wrinkled green, so round green and wrinkled yellow are new combinations.

Codex, slide 75 · Independent assortment (dihybrid cross) · Devil

94. A cross gives offspring in a 9:3:3:1 ratio but the parental genotypes are unknown. What can the geneticist postulate?

A A single gene pair showing incomplete dominance in the F1

B Two independent pairs of alleles, one member of each acting as dominant

C Two linked genes that are always inherited together as one

D A single gene with four different alleles in the population

Answer 94: B

Correct. A 9:3:3:1 ratio points to two independent gene pairs with dominance at each.

Codex, slide 76 · Independent assortment (dihybrid cross) · Devil

95. A dihybrid F1 is backcrossed to the full recessive parent. What ratio is expected, and why?

A 9:3:3:1, because the F1 makes four equal gamete types

B 1:1:1:1, because the F1 makes only two gamete types

C 3:1, because each gene pair gives a 3:1 ratio on its own

D 1:1:1:1: four equal F1 gamete types and one tester gamete type

Answer 95: D

Correct. Four equal gamete types from the F1 combine with the single gamete type from the tester.

Codex, slide 72-73 · Independent assortment (dihybrid cross) · Devil

96. A dihybrid F1 (GgWw) is self-fertilized and gives 320 F2 seeds. How many are expected to be heterozygous for both genes (GgWw)?

A 80

B 180

C 20

D 160

Answer 96: A

Correct. The chance is 1/2 × 1/2 = 1/4, and 1/4 of 320 is 80.

Codex, slide 68-73 · Independent assortment (dihybrid cross) · Devil

97. Among the F2 seeds that are round and yellow from GgWw × GgWw, what fraction is GgWw?

A 1/4

B 9/16

C 4/9

D 1/2

Answer 97: C

Correct. Round yellow is 9/16 of the F2 and GgWw is 4/16, so within round yellow it is 4/9.

Codex, slide 99-100 · Independent assortment (dihybrid cross) · Devil

98. Two double heterozygotes are crossed and give mostly parental types with few new combinations, instead of 9:3:3:1. Which explanation is best?

A Dominance is absent at both of the gene loci in the cross

B Segregation did not occur in either of the parents' gametes

C They may not assort independently, e.g. if linked on one chromosome

D The sample of offspring was far too large to be reliable

> **Answer 98: C**
>
> Correct. A 9:3:3:1 ratio depends on independent assortment; departures suggest the assumption fails.

Codex, slide 70-73 · Independent assortment (dihybrid cross) · Devil

99. A GgWw plant is self-fertilized and produces 640 F2 seeds. How many are expected to be homozygous for both genes?

A 160
B 40
C 80
D 360

> **Answer 99: A**
>
> Correct. GGWW, GGww, ggWW and ggww are each 1/16, so 4/16 of 640 is 160.

Codex, slide 70-71, 94 · Independent assortment (dihybrid cross) · Devil

100. A student says the 9:3:3:1 ratio means there are nine genotypes in those proportions. What is wrong with this?

A 9:3:3:1 is a genotypic ratio, and only four genotypes exist in the F2
B 9:3:3:1 is a phenotypic ratio; the nine genotypes follow 1:2:1:2:4:2:1:2:1
C The nine genotypes occur in equal numbers in the F2 plants
D Sixteen genotypes occur in the ratio 9:3:3:1 among the plants

> **Answer 100: B**
>
> Correct. Genotype classes include GGWW, GGWw and others in proportions summing to 16.

2. Trihybrid cross and forked-line

Codex, slide 78-79 · Trihybrid cross and forked-line · Easy

101. How many gene pairs are involved in a trihybrid cross?

A Two
B Four
C Six
D Three

> **Answer 101: D**
>
> Correct. A trihybrid cross follows three gene pairs at once.

Codex, slide 81 · Trihybrid cross and forked-line · Medium

102. What is the F1 genotype of the cross DDGGWW × ddggww?

A DdGgWw
B DDGGWW
C ddggww
D DdGgWW

> **Answer 102: A**
>
> Correct. Each F1 plant receives DGW from one parent and dgw from the other.

Codex, slide 84-86 · Trihybrid cross and forked-line · Medium

103. Why is the forked-line method preferred for a trihybrid F1 × F1 cross?

A The forked-line method works only when the genes are linked

B The forked-line method changes the ratio to a 9:3:3:1 pattern

C A Punnett square needs 64 squares; forked-line combines three simple crosses

D A Punnett square cannot be used at all for a trihybrid cross

> **Answer 103: C**
>
> Correct. Treating the cross as three monohybrid crosses avoids a cumbersome 64-square table.

Codex, slide 80-81 · Trihybrid cross and forked-line · Medium

104. Parents DDGGww and ddggWW are crossed. Which genotype do the F1 hybrids have?

A DDGGWW

B ddggww

C DdGgww

D DdGgWw

> **Answer 104: D**
>
> Correct. Each parent supplies one allele of every gene, making the F1 heterozygous at all three loci.

Codex, slide 84 · Trihybrid cross and forked-line · Hard

105. If one member of each pair is dominant, what phenotypic ratio is expected from DdGgWw × DdGgWw?

A 9:3:3:1

B 27:9:9:9:3:3:3:1

C 3:1

D 1:1:1:1:1:1:1:1

> **Answer 105: B**
>
> Correct. Combining three 3:1 crosses gives eight phenotypic classes in this ratio.

Codex, slide 85-86 · Trihybrid cross and forked-line · Hard

106. Using the forked-line method, what fraction of DdGgWw × DdGgWw offspring show the dominant phenotype for all three traits?

A 9/16

B 27/64

C 3/8

D 1/4

> **Answer 106: B**
>
> Correct. (3/4) × (3/4) × (3/4) = 27/64.

Codex, slide 85-86 · Trihybrid cross and forked-line · Hard

107. What fraction of DdGgWw × DdGgWw offspring show the recessive phenotype for all three traits?

A 1/8
B 1/16
C 1/4
D 1/64

> **Answer 107: D**
> Correct. (1/4) × (1/4) × (1/4) = 1/64.

Codex, slide 88 · Trihybrid cross and forked-line · Hard

108. What fraction of DdGgWw × DdGgWw offspring have the genotype DdGgWw?

A 1/64
B 1/4
C 1/8
D 27/64

> **Answer 108: C**
> Correct. Each pair gives 1/2 Dd-type heterozygotes, so $(1/2)^3 = 1/8$.

Codex, slide 82 · Trihybrid cross and forked-line · Hard

109. In the testcross DdGgWw × ddggww, how many kinds of gametes does each parent produce?

A Eight from the F1, one from the recessive
B Four kinds from each of the two parents
C Eight kinds from each of the two parents
D One from the F1 and eight from the recessive parent

> **Answer 109: A**
> Correct. The triple heterozygote gives $2^3 = 8$ gamete types and the full recessive gives only dgw.

Codex, slide 85-86 · Trihybrid cross and forked-line · Hard

110. In DdGgWw × DdGgWw, what fraction of offspring are recessive for D and G but dominant for W?

A 9/64
B 1/64
C 27/64
D 3/64

> **Answer 110: D**
> Correct. (1/4) × (1/4) × (3/4) = 3/64.

Codex, slide 88 · Trihybrid cross and forked-line · Hard

111. In DdGgWw × DdGgWw, what fraction of offspring have the genotype DDGgww?

A 1/32
B 1/64
C 1/16
D 3/32

> **Answer 111: A**
> Correct. (1/4) × (1/2) × (1/4) = 1/32.

Codex, slide 88 · Trihybrid cross and forked-line · Hard

112. In DdGgWw × DdGgWw, what fraction of offspring are homozygous at all three loci?

A 1/64
B 1/8
C 1/4
D 3/8

> **Answer 112: B**
> Correct. (1/2) × (1/2) × (1/2) = 1/8, since half of each pair's offspring are homozygous.

Codex, slide 88 · Trihybrid cross and forked-line · Hard

113. Crossing two DdGgWw plants, what proportion of the progeny are heterozygous at exactly one locus?

A 1/8
B 1/2
C 3/8
D 27/64

> **Answer 113: C**
> Correct. Three choices of locus × $(1/2)^3$ = 3/8.

Codex, slide 84-86 · Trihybrid cross and forked-line · Hard

114. A trihybrid F1 × F1 cross produces 640 F2 plants. How many are expected to be dominant for all three traits?

A 360
B 90
C 540
D 270

> **Answer 114: D**
> Correct. 27/64 of 640 is 270.

Codex, slide 84-86 · Trihybrid cross and forked-line · Hard

115. A trihybrid F1 × F1 cross produces 640 F2 plants. How many are expected to be recessive for all three traits?

A 20
B 40
C 10
D 80

> **Answer 115: C**
> Correct. 1/64 of 640 is 10.

Codex, slide 84-86 · Trihybrid cross and forked-line · Hard

116. In DdGgWw × DdGgWw, what fraction of offspring show exactly two dominant traits?

A 9/64
B 27/64
C 1/4
D 3/8

> **Answer 116: B**
> Correct. Three combinations × $(3/4)^2$ × (1/4) = 27/64.

Codex, slide 84 · Trihybrid cross and forked-line · Hard

117. Which F2 phenotype class forms the "27" part of the 27:9:9:9:3:3:3:1 ratio?

A Dominant for all three traits
B Recessive for all three traits
C Dominant for exactly one trait
D Dominant for exactly two traits

> **Answer 117: A**
> Correct. The largest class shows all three dominant phenotypes.

Codex, slide 84 · Trihybrid cross and forked-line · Hard

118. In the 27:9:9:9:3:3:3:1 ratio, what are the three "9" classes?

A Dominant for two traits and recessive for one
B Dominant for all three traits, with none recessive
C Dominant for only one trait and recessive for two
D Recessive for all three traits, with none dominant

> **Answer 118: A**
> Correct. Each "9" class is recessive for one of the three traits only.

Codex, slide 71, 84 · Trihybrid cross and forked-line · Hard

119. The F2 ratio 27:9:9:9:3:3:3:1 equals (3:1) raised to which power?

A 2

B 6

C 3

D 8

> **Answer 119: C**
>
> Correct. Three independent gene pairs each give 3:1, so the combined ratio is $(3:1)^3$.

Codex, slide 82 · Trihybrid cross and forked-line · Devil

120. In the testcross DdGgWw × ddggww, how many phenotypic classes are expected and in what proportions?

A Eight classes in a 27:9:9:9:3:3:3:1 ratio

B Four classes, each 1/4 of the offspring

C Two classes in a 3:1 ratio of offspring

D Eight classes, each 1/8 of the offspring

> **Answer 120: D**
>
> Correct. The F1 makes eight gamete types equally and the tester makes one, giving eight equal classes.

Codex, slide 82, 84 · Trihybrid cross and forked-line · Devil

121. How many gamete types does each DdGgWw parent make, and how many squares does the Punnett square need?

A 4 gamete types; 16 squares

B 8 gamete types; 64 squares

C 4 gamete types; 64 squares

D 8 gamete types; 16 squares

> **Answer 121: B**
>
> Correct. Eight gamete types per parent give 8 × 8 = 64 squares.

Codex, slide 85-86 · Trihybrid cross and forked-line · Devil

122. In a DdGgWw × DdGgWw cross, what is the probability that an offspring shows the dominant phenotype for traits D and G but the recessive phenotype for trait W?

A 27/64

B 3/64

C 9/64

D 1/64

> **Answer 122: C**
>
> Correct. (3/4) × (3/4) × (1/4) = 9/64.

Codex, slide 84-86 · Trihybrid cross and forked-line · Devil

123. Among F2 plants that are dominant for all three traits in a DdGgWw × DdGgWw cross, what fraction is DdGgWw?

A 1/8
B 27/64
C 1/27
D 8/27

> **Answer 123: D**
> Correct. Among dominant-trait plants, each pair is Dd with probability 2/3, so $(2/3)^3 = 8/27$.

3. Gametes, genotypes and phenotypes

Codex, slide 93 · Gametes, genotypes and phenotypes · Easy

124. An individual is heterozygous for n independent gene pairs. How many kinds of gametes can it produce?

A 3^n
B 2^n
C 2n
D n^2

> **Answer 124: B**
> Correct. Each heterozygous pair doubles the number of gamete types, giving 2^n.

Codex, slide 93 · Gametes, genotypes and phenotypes · Easy

125. How many different gametes can a plant with the genotype AaBbCc produce?

A 8
B 6
C 9
D 3

> **Answer 125: A**
> Correct. Three heterozygous pairs give $2^3 = 8$ gamete types.

Codex, slide 94 · Gametes, genotypes and phenotypes · Easy

126. With dominance at both genes, how many F2 phenotypes appear in a dihybrid cross?

A 2
B 4
C 9
D 16

> **Answer 126: B**
> Correct. The F2 shows four phenotypes in a 9:3:3:1 ratio.

Codex, slide 82 · Gametes, genotypes and phenotypes · Medium

127. How many kinds of gametes can a DdGgWw plant produce?

A 8

B 6

C 9

D 27

> **Answer 127: A**
>
> Correct. Three heterozygous pairs give $2^3 = 8$ gamete types.

Codex, slide 93 · Gametes, genotypes and phenotypes · Medium

128. A plant has the genotype AaBBCCDd. How many different gamete types can it form?

A 8

B 16

C 2

D 4

> **Answer 128: D**
>
> Correct. Only Aa and Dd are heterozygous, so $2^2 = 4$.

Codex, slide 93-94 · Gametes, genotypes and phenotypes · Medium

129. A plant with genotype AaBbCc is self-fertilized. How many different F2 genotypes are possible?

A 9

B 8

C 27

D 64

> **Answer 129: C**
>
> Correct. Each of three heterozygous pairs gives three genotypes, so $3^3 = 27$.

Codex, slide 93-94 · Gametes, genotypes and phenotypes · Medium

130. A plant with genotype AaBbCc is self-fertilized, with dominance at every gene. How many different F2 phenotypes appear?

A 27

B 8

C 6

D 16

> **Answer 130: B**
>
> Correct. Phenotypes number 2^n with dominance, so $2^3 = 8$.

Codex, slide 93-94 · Gametes, genotypes and phenotypes · Medium

131. A plant with genotype AaBbCcDd is testcrossed to aabbccdd. How many offspring classes appear, and how are they distributed?

A 16 classes in equal proportions

B 8 classes in equal proportions

C 16 classes in a 9:3:3:1-based ratio

D 81 classes in equal proportions

> **Answer 131: A**
>
> Correct. Four heterozygous pairs give $2^4 = 16$ gamete types, each equally frequent.

Codex, slide 94 · Gametes, genotypes and phenotypes · Hard

132. A plant heterozygous for four independent gene pairs is self-fertilized. How many F2 genotypes and phenotypes are expected, with dominance at each?

A 16 genotypes and 81 phenotypes

B 64 genotypes and 16 phenotypes

C 81 genotypes and 81 phenotypes

D 81 genotypes and 16 phenotypes

> **Answer 132: D**
>
> Correct. For n = 4, genotypes are $3^4 = 81$ and phenotypes are $2^4 = 16$.

Codex, slide 92-94 · Gametes, genotypes and phenotypes · Hard

133. Why does the number of F2 genotypes follow 3^n for n heterozygous gene pairs?

A Each pair gives two genotypes, and pairs multiply

B Each pair gives three genotypes (1:2:1), and pairs add

C Each pair gives three genotypes (1:2:1), and pairs multiply

D The number of genotypes equals the number of Punnett squares

> **Answer 133: C**
>
> Correct. Three genotypes per pair, multiplied across n pairs, gives 3^n.

Codex, slide 93-94 · Gametes, genotypes and phenotypes · Hard

134. For n independent heterozygous gene pairs with dominance, which statements are correct?

1. The number of gamete types is 2^n.

2. The number of F2 genotypes is 3^n.

3. The number of F2 phenotypes is 3^n.

A 1 and 3 only

B 2 and 3 only

C 1, 2 and 3

D 1 and 2 only

Answer 134: D

Correct. Gametes are 2^n and genotypes are 3^n; phenotypes are 2^n with dominance, not 3^n.

Codex, slide 94 · Gametes, genotypes and phenotypes · Hard

135. How many genotypes appear in the F2 of a dihybrid cross, and how many of them are homozygous for both genes?

A 9 genotypes; 2 are homozygous for both genes

B 9 genotypes; 4 are homozygous for both genes

C 4 genotypes; 4 are homozygous for both genes

D 16 genotypes; 4 are homozygous for both genes

Answer 135: B

Correct. The nine genotypes include GGWW, GGww, ggWW and ggww.

Codex, slide 82, 93 · Gametes, genotypes and phenotypes · Hard

136. A plant of genotype AaBbCc is testcrossed and produces 400 offspring. How many are expected in each phenotypic class?

A 100

B 25

C 50

D 200

Answer 136: C

Correct. Eight equally frequent classes give 400/8 = 50 each.

Codex, slide 93-94 · Gametes, genotypes and phenotypes · Devil

137. How many gamete types and F2 genotypes can come from selfing an AaBbCCDd plant, with all gene pairs independent?

A 16 gamete types and 81 F2 genotypes

B 8 gamete types and 81 F2 genotypes

C 4 gamete types and 27 F2 genotypes

D 8 gamete types and 27 F2 genotypes

Answer 137: D

Correct. Only three pairs are heterozygous, so gametes are $2^3 = 8$ and genotypes are $3 \times 3 \times 1 \times 3 = 27$.

Codex, slide 93 · Gametes, genotypes and phenotypes · Devil

138. A plant heterozygous for five independent gene pairs is testcrossed. How many phenotypic classes appear, and how are they distributed?

A 32 classes in equal proportions

B 25 classes in equal proportions

C 32 classes in a 9:3:3:1-based ratio

D 10 classes in equal proportions

Answer 138: A

Correct. 2^5 gamete types give 32 equally frequent testcross classes.

Codex, slide 94 · Gametes, genotypes and phenotypes · Devil

139. A dihybrid F2 has nine genotypes but only four phenotypes with dominance. Why the difference?

A Five of the genotypes are lost before the plants are counted

B Several genotypes look alike because dominant alleles mask recessives

C Recessive alleles change the phenotype of heterozygotes

D Phenotypes are counted per gamete instead of per plant

Answer 139: B

Correct. For example GGWW, GgWW, GGWw and GgWw all look round and yellow.

Codex, slide 93-94 · Gametes, genotypes and phenotypes · Devil

140. A plant of genotype AaBbCcDdEe is self-fertilized. How many gamete types and F2 genotypes are possible?

A 32 gamete types and 81 F2 genotypes

B 16 gamete types and 243 F2 genotypes

C 32 gamete types and 125 F2 genotypes

D 32 gamete types and 243 F2 genotypes

Answer 140: D

Correct. Five heterozygous pairs give $2^5 = 32$ gamete types and $3^5 = 243$ genotypes.

Module 3: Chi-square analysis — 70 questions

1. Chance deviation and assumptions

Codex, slide 99-100 · Chance deviation and assumptions · Medium

141. Which of the following is NOT one of the four assumptions behind Mendel's 3:1 and 9:3:3:1 ratios as listed in the lecture?

A Dominance and recessiveness of alleles

B Segregation of the paired alleles

C Linkage between the two genes

D Random fertilization of the gametes

> **Answer 141: C**
>
> Correct. The four listed assumptions are dominance, segregation, independent assortment and random fertilization; linkage is not among them.

Codex, slide 99-100 · Chance deviation and assumptions · Medium

142. Which of Mendel's four assumptions is NOT described as influenced by chance events?

A Dominance and recessiveness

B Segregation

C Independent assortment

D Random fertilization

> **Answer 142: A**
>
> Correct. The lecture says the last three are subject to chance deviation.

Codex, slide 101-103 · Chance deviation and assumptions · Medium

143. Why does chance deviation matter more when fewer offspring are counted?

A A small sample changes the genotypes of the parent plants

B A small sample is pulled off the expected ratio more easily by chance

C Small samples cannot show dominance or recessiveness at all

D Chance acts only in large samples, never in small ones

> **Answer 143: B**
>
> Correct. The smaller the sample, the greater the impact of chance deviation.

Codex, slide 101 · Chance deviation and assumptions · Hard

144. Why can four coin tosses give all heads when 1000 tosses practically cannot?

A Coins are fair only when they are tossed in large samples

B Large samples remove every chance effect from the results

C Heads become less likely after each earlier heads toss

D The smaller the sample, the greater the impact of chance

> **Answer 144: D**
> Correct. Chance deviation matters far more in small samples.

Codex, slide 101-103 · Chance deviation and assumptions · Hard

145. Which sample is expected to show the smallest chance deviation from a 3:1 ratio?

A 40 offspring
B 400 offspring
C 4000 offspring
D 4 offspring

> **Answer 145: C**
> Correct. The larger the sample, the smaller the impact of chance deviation.

Codex, slide 101-103 · Chance deviation and assumptions · Devil

146. Two experiments are tested against a 3:1 hypothesis. In A, 20 progeny give 12 dominant and 8 recessive. In B, 2000 progeny give 1200 dominant and 800 recessive. Which statement is correct?

A B has a far larger chi-square: the same split is less likely by chance in a large sample
B Both give the same chi-square, because the percentage split is the same in each
C A has the larger chi-square, because it has fewer offspring in total
D Neither can be tested, because a 3:1 test needs exact counts of offspring

> **Answer 146: A**
> Correct. A gives $\chi^2 \approx 2.4$ and B gives ≈ 240, because the impact of chance deviation shrinks as the sample grows.

Codex, slide 104-108 · Chance deviation and assumptions · Devil

147. What question is a chi-square genetic test asking?

A Whether the difference between observed and expected counts is due to chance
B Whether the offspring were all produced by heterozygous parents
C Whether the parents of the cross were true-breeding pure lines
D Whether the expected counts are correct for every possible sample

> **Answer 147: A**
> Correct. The test estimates how often the deviation would occur strictly due to chance.

2. Chi-square formula and calculation

Codex, slide 109 · Chi-square formula and calculation · Easy

148. In the formula $\chi^2 = \Sigma(o - e)^2/e$, what does "o" stand for?

A The odds ratio of the two classes
B The observed count for a category
C The original sample size of the cross
D The overall probability of the outcome

> **Answer 148: B**
>
> Correct. "o" is the observed count in each category and "e" is the expected count.

Codex, slide 104-106 · Chi-square formula and calculation · Easy

149. Which statistical test is used to judge how well observed genetic data fit an expected ratio?

A A t-test of two means

B Correlation analysis

C Chi-square analysis

D A Punnett square

> **Answer 149: C**
>
> Correct. Chi-square tests goodness of fit between observed and expected counts.

Codex, slide 108 · Chi-square formula and calculation · Medium

150. Which formula is used in chi-square analysis?

A $\chi^2 = \Sigma(o - e)/e$

B $\chi^2 = \Sigma(o + e)^2/e$

C $\chi^2 = \Sigma(o - e)^2 \times e$

D $\chi^2 = \Sigma(o - e)^2/e$

> **Answer 150: D**
>
> Correct. Each deviation is squared and divided by the expected value, then summed.

Codex, slide 104-105 · Chi-square formula and calculation · Medium

151. What does a chi-square goodness-of-fit test tell a geneticist?

A Which allele of a gene is dominant over the other alleles

B How well observed results fit an expected ratio, allowing for chance

C How many separate genes control the trait being studied

D The exact genotype of each individual offspring in the cross

> **Answer 151: B**
>
> Correct. Goodness of fit compares observed and expected results to judge whether the difference is acceptable.

Codex, slide 108-110 · Chi-square formula and calculation · Medium

152. In a cross of round and wrinkled pea seeds expected to give 3:1, 400 seeds are counted: 290 round and 110 wrinkled. What is the χ^2 value?

A About 200

B About 1.25

C About 0.13

D About 1.33

Answer 152: D

Correct. Expected counts are 300, 100; $\chi^2 = 0.33 + 1.00 = 1.33$.

Codex, slide 108-110 · Chi-square formula and calculation · Medium

153. A 3:1 ratio is expected for inflated and constricted pods. Among 160 plants, 118 have inflated pods and 42 constricted pods. What is the χ^2 value?

A About 0.13

B About 8.00

C About 0.07

D About 0.10

Answer 153: A

Correct. Expected counts are 120, 40; $\chi^2 = 0.03 + 0.10 = 0.13$.

Codex, slide 108-110; general · Chi-square formula and calculation · Medium

154. A heterozygote is testcrossed and expected to give 1:1. Among 200 offspring, 112 are of one class and 88 of the other. What is the χ^2 value?

A About 288

B About 2.92

C About 2.88

D About 0.24

Answer 154: C

Correct. Expected counts are 100, 100; $\chi^2 = 1.44 + 1.44 = 2.88$.

Codex, slide 108-110; general · Chi-square formula and calculation · Medium

155. A testcross is expected to give 1:1. Among 60 offspring, 36 show one phenotype and 24 the other. What is the χ^2 value?

A About 72.00

B About 2.40

C About 2.50

D About 0.40

Answer 155: B

Correct. Expected counts are 30, 30; $\chi^2 = 1.20 + 1.20 = 2.40$.

Codex, slide 110 · Chi-square formula and calculation · Medium

156. A 3:1 cross yields 520 offspring. How many recessive offspring are expected?

A 390

B 260

C 173

D 130

Answer 156: D

Correct. One quarter of 520 is 130.

Codex, slide 111 · Chi-square formula and calculation · Medium

157. An F2 of 800 seeds is tested against 9:3:3:1. How many round, yellow seeds are expected?

A 450

B 150

C 50

D 600

Answer 157: A

Correct. Nine sixteenths of 800 is 450.

Codex, slide 110-113; general · Chi-square formula and calculation · Medium

158. A cross is expected to give a 1:2:1 ratio and produces 400 offspring. How many heterozygous offspring are expected?

A 100

B 300

C 200

D 133

Answer 158: C

Correct. The middle class is two quarters of 400, or 200.

Codex, slide 76, 108; general · Chi-square formula and calculation · Medium

159. A dihybrid testcross is expected to give 1:1:1:1 among 360 offspring. How many are expected in each class?

A 120

B 60

C 180

D 90

Answer 159: D

Correct. Four equal classes give 360/4 = 90 each.

Codex, slide 107-109 · Chi-square formula and calculation · Medium

160. As observed numbers move further from the expected numbers, what happens to χ^2?

A It increases

B It decreases

C It stays at zero

D It becomes negative

> **Answer 160: A**
>
> Correct. Larger deviations give larger squared deviations and a larger χ^2.

Codex, slide 108-109 · Chi-square formula and calculation · Medium

161. What is χ^2 if every observed count equals its expected count?

A 1

B 0

C The total number of offspring

D It cannot be calculated

> **Answer 161: B**
>
> Correct. Every deviation is zero, so the sum is zero.

Codex, slide 110 · Chi-square formula and calculation · Hard

162. In a 3:1 test with 1000 offspring, the observed counts are 740 dominant and 260 recessive. What is the chi-square contribution of the dominant class?

A About 0.40

B About 0.53

C About 0.13

D About 1.33

> **Answer 162: C**
>
> Correct. Expected is 750, so $(740 - 750)^2/750 = 100/750 \approx 0.13$.

Codex, slide 110 · Chi-square formula and calculation · Hard

163. For the same data (740 dominant, 260 recessive; expected 750 and 250), what is the total chi-square value?

A About 0.53

B About 0.26

C About 1.06

D About 0.13

> **Answer 163: A**
>
> Correct. 0.13 + 0.40 gives about 0.53.

Codex, slide 108-110 · Chi-square formula and calculation · Hard

164. A cross is expected to give a 3:1 ratio. Among 200 offspring, 152 are dominant and 48 are recessive. What is the chi-square value?

A About 0.04

B About 1.07

C About 0.11

D About 4.00

Answer 164: C

Correct. Expected are 150 and 50: 4/150 + 4/50 ≈ 0.03 + 0.08 ≈ 0.11.

Codex, slide 111 · Chi-square formula and calculation · Hard

165. In the dihybrid example, the four class contributions are 0.71, 0.34, 2.36 and 0.77. What is the total chi-square value?

A 4.81

B 3.41

C 1.05

D 4.18

Answer 165: D

Correct. 0.71 + 0.34 + 2.36 + 0.77 = 4.18.

Codex, slide 108-109; general · Chi-square formula and calculation · Hard

166. Why is each deviation (o − e) squared in the chi-square formula?

A To convert each deviation directly into a probability value

B So positive and negative deviations cannot cancel and big ones weigh more

C Because squaring is needed only when the sample is below 100

D To make the degrees of freedom equal to one in every case

Answer 166: B

Correct. Squaring keeps every deviation positive and gives large deviations more weight.

Codex, slide 111 · Chi-square formula and calculation · Hard

167. In the dihybrid example (expected 563, 187, 187, 63; observed 583, 195, 166, 56), which class contributes most to the chi-square value?

A The 9/16 class with 583 observed

B The 3/16 class with 166 observed

C The 3/16 class with 195 observed

D The 1/16 class with 56 observed

Answer 167: B

Correct. That class contributes 2.36, much more than any other.

Codex, slide 108-110 · Chi-square formula and calculation · Hard

168. A cross of purple- and white-flowered peas is expected to give 3:1. Among 600 offspring, 460 are purple and 140 are white. What is the χ^2 value?

A About 200

B About 0.93

C About 0.89

D About 0.09

Answer 168: C

Correct. Expected counts are 450, 150; $\chi^2 = 0.22 + 0.67 = 0.89$.

Codex, slide 108-110 · Chi-square formula and calculation · Hard

169. A cross of yellow- and green-seeded peas is expected to give 3:1. Of 120 seeds, 87 are yellow and 33 are green. What is the χ^2 value?

A About 18.00

B About 0.38

C About 0.13

D About 0.40

Answer 169: D

Correct. Expected counts are 90, 30; $\chi^2 = 0.10 + 0.30 = 0.40$.

Codex, slide 108-110 · Chi-square formula and calculation · Hard

170. A cross of tall and dwarf peas is expected to give 3:1. Of 800 plants, 640 are tall and 160 are dwarf. What is the χ^2 value?

A About 10.67

B About 3200

C About 12.50

D About 0.27

Answer 170: A

Correct. Expected counts are 600, 200; $\chi^2 = 2.67 + 8.00 = 10.67$.

Codex, slide 108-110 · Chi-square formula and calculation · Hard

171. Axial and terminal flower positions are expected to appear 3:1. Among 500 plants, 366 are axial and 134 are terminal. What is the χ^2 value?

A About 162

B About 0.83

C About 0.10

D About 0.86

Answer 171: D

Correct. Expected counts are 375, 125; $\chi^2 = 0.22 + 0.65 = 0.86$.

Codex, slide 108-110 · Chi-square formula and calculation · Hard

172. A 3:1 ratio is expected for green and yellow pods. Among 300 plants, 208 have green pods and 92 yellow pods. What is the χ^2 value?

A About 578

B About 5.14

C About 4.53

D About 0.30

Answer 172: B

Correct. Expected counts are 225, 75; $\chi^2 = 1.28 + 3.85 = 5.14$.

Codex, slide 76, 108-110; general · Chi-square formula and calculation · Hard

173. A dihybrid testcross is expected to give 1:1:1:1. Among 200 offspring the four classes number 58, 45, 52 and 45. What is the χ^2 value?

A About 2.36

B About 118

C About 2.29

D About 0.40

Answer 173: A

Correct. Expected counts are 50, 50, 50, 50; $\chi^2 = 1.28 + 0.50 + 0.08 + 0.50 = 2.36$.

Codex, slide 76, 108-110; general · Chi-square formula and calculation · Hard

174. A second dihybrid testcross, again expected to give 1:1:1:1, produced 400 offspring in classes of 92, 110, 104 and 94. Calculate χ^2.

A About 216

B About 2.14

C About 2.16

D About 0.28

Answer 174: C

Correct. Expected counts are 100, 100, 100, 100; $\chi^2 = 0.64 + 1.00 + 0.16 + 0.36 = 2.16$.

Codex, slide 111 · Chi-square formula and calculation · Hard

175. A dihybrid F2 of 320 plants is tested against 9:3:3:1 (expected 180, 60, 60, 20). The observed numbers are 176, 70, 51 and 23. Which class contributes most to χ^2?

A The 9/16 class (176 observed)

B The first 3/16 class (70 observed)

C The second 3/16 class (51 observed)

D The 1/16 class (23 observed)

Answer 175: B

Correct. It contributes $100/60 \approx 1.67$, more than any other class.

Codex, slide 108-109; general · Chi-square formula and calculation · Hard

176. A student calculates $\chi^2 = -2.3$ for a 3:1 test. What should the student conclude?

A The data fit the 3:1 ratio especially well, with a small χ^2

B The 3:1 hypothesis must be rejected because χ^2 is so small

C The degrees of freedom for the test must also be negative

D A mistake was made, since squared deviations cannot give a negative χ^2

> **Answer 176: D**
>
> Correct. Every term is a squared deviation divided by a positive expected value.

Codex, slide 108-109 · Chi-square formula and calculation · Hard

177. Why is each squared deviation divided by its expected value in the formula?

A To convert each deviation into the degrees of freedom

B To make the total of the terms equal to the sample size

C To scale the deviation to the expected count's size

D To remove the effect of dominance from the deviation

> **Answer 177: C**
>
> Correct. A deviation of 10 matters more against an expected 50 than against an expected 5000.

Codex, slide 112-114 · Chi-square formula and calculation · Hard

178. According to the lecture, what comes right after calculating the χ^2 value?

A Determine the degrees of freedom

B Calculate the expected values again

C Reject the hypothesis

D Count the offspring again

> **Answer 178: A**
>
> Correct. The lecture says first to determine the degrees of freedom, then convert χ^2 to P.

Codex, slide 100, 110-113 · Chi-square formula and calculation · Devil

179. A dihybrid cross of 160 offspring gives 96 : 28 : 26 : 10 for the four phenotypes. Tested against 9:3:3:1, what are the chi-square value and degrees of freedom?

A About 1.07 with 1 degree of freedom

B About 1.07 with 3 degrees of freedom

C About 56 with 3 degrees of freedom

D About 0.27 with 4 degrees of freedom

> **Answer 179: B**
>
> Correct. Expected counts are 90, 30, 30 and 10, so $\chi^2 \approx 0.40 + 0.13 + 0.53 + 0 \approx 1.07$ with $4 - 1 = 3$ degrees of freedom.

Codex, slide 108-111 · Chi-square formula and calculation · Devil

180. Round yellow, round green, wrinkled yellow and wrinkled green seeds number 265, 100, 82 and 33 in an F2 of 480. Tested against 9:3:3:1, what is χ^2?

A About 2.21

B About 198

C About 2.15

D About 0.32

Answer 180: A

Correct. Expected counts are 270, 90, 90, 30; $\chi^2 = 0.09 + 1.11 + 0.71 + 0.30 = 2.21$.

Codex, slide 108-111 · Chi-square formula and calculation · Devil

181. A pea F2 of 640 plants splits into 350, 135, 115 and 40 across the four phenotype classes. What χ^2 results against 9:3:3:1?

A About 350

B About 2.17

C About 2.36

D About 0.19

Answer 181: C

Correct. Expected counts are 360, 120, 120, 40; $\chi^2 = 0.28 + 1.88 + 0.21 + 0.00 = 2.36$.

Codex, slide 108-111 · Chi-square formula and calculation · Devil

182. In an F2 of 320 plants, the four classes are 186, 55, 58 and 21. Compute χ^2 for the hypothesis 9:3:3:1.

A About 66.00

B About 0.76

C About 0.20

D About 0.73

Answer 182: D

Correct. Expected counts are 180, 60, 60, 20; $\chi^2 = 0.20 + 0.42 + 0.07 + 0.05 = 0.73$.

Codex, slide 111 · Chi-square formula and calculation · Devil

183. In a 640-plant F2 tested against 9:3:3:1, the expected classes are 360, 120, 120 and 40, and the observed are 371, 110, 127 and 32. Which class adds most to χ^2?

A The 1/16 class (32 observed)

B The 9/16 class (371 observed)

C The first 3/16 class (110 observed)

D The second 3/16 class (127 observed)

Answer 183: A

Correct. It contributes 64/40 = 1.60, because a small expected count magnifies the deviation.

Codex, slide 108-109; general · Chi-square formula and calculation · Devil

184. Every observed and expected count in a test is doubled, keeping the same proportions. What happens to χ^2?

A It stays the same

B It doubles

C It halves

D It becomes zero

Answer 184: B

Correct. Each term $(2d)^2/(2e)$ equals twice d^2/e.

Codex, slide 104-114 · Chi-square formula and calculation · Devil

185. Which sequence of steps for a chi-square test is correct?

A Compute χ^2, state the ratio, find df, find P, find expected counts, decide

B Decide, compute χ^2, state the ratio, find df, find expected counts, find P

C State the ratio, find expected counts, compute χ^2, find df, convert to P, decide

D Find P, find expected counts, state the ratio, compute χ^2, find df, decide

Answer 185: C

Correct. Expected counts come from the hypothesised ratio, and the decision comes last.

3. Degrees of freedom

Codex, slide 112-113 · Degrees of freedom · Easy

186. How many degrees of freedom apply to a test of a 3:1 ratio?

A 2

B 3

C 4

D 1

Answer 186: D

Correct. There are two categories, so df = 2 − 1 = 1.

Codex, slide 112-113; general · Degrees of freedom · Easy

187. How many degrees of freedom apply to a test of a 1:2:1 ratio?

A 3

B 1

C 2

D 4

Answer 187: C

Correct. There are three categories, so df = 3 − 1 = 2.

Codex, slide 112-113 · Degrees of freedom · Medium

188. Why is the degrees of freedom 1 for a 3:1 ratio but 3 for a 9:3:3:1 ratio?

A Degrees of freedom equal the number of offspring minus one

B Degrees of freedom equal the largest number in the ratio

C Degrees of freedom equal the number of genes in the cross

D Degrees of freedom equal the categories minus one: 2 − 1 and 4 − 1

Answer 188: D

Correct. A 3:1 ratio has two categories and 9:3:3:1 has four.

Codex, slide 112-113; general · Degrees of freedom · Medium

189. How many degrees of freedom apply to a test of a 1:1:1:1 ratio?

A 4
B 3
C 2
D 1

> **Answer 189: B**
> Correct. There are four categories, so df = 4 − 1 = 3.

Codex, slide 112-113; general · Degrees of freedom · Hard

190. A trihybrid F2 is tested against 27:9:9:9:3:3:3:1. How many degrees of freedom apply?

A 7
B 8
C 6
D 63

> **Answer 190: A**
> Correct. There are eight categories, so df = 8 − 1 = 7.

Codex, slide 114 · Degrees of freedom · Hard

191. Why must degrees of freedom be considered when interpreting χ^2?

A Degrees of freedom change the observed counts in the data
B More categories mean more deviation is expected by chance
C More categories make the test stricter in every case
D Degrees of freedom replace the sample size in the formula

> **Answer 191: B**
> Correct. The lecture says df must always be considered for this reason.

Codex, slide 112-114; general · Degrees of freedom · Hard

192. A 3:1 test and a 9:3:3:1 test both give $\chi^2 = 2.4$. What is true about their P values?

A They are identical because χ^2 is identical
B The 3:1 test has the larger P, since it has fewer categories
C Both are below 0.05
D They differ, because the degrees of freedom differ

> **Answer 192: D**
> Correct. The same χ^2 corresponds to different P values at 1 and 3 degrees of freedom.

Codex, slide 112-114; general · Degrees of freedom · Devil

193. A student tests a 9:3:3:1 hypothesis but uses 1 degree of freedom instead of 3. For the same χ^2, how does the P value compare with the correct one?

A It is smaller, risking rejection of a hypothesis that actually fits

B It is larger, so a poorly fitting hypothesis might be accepted

C It is identical, because degrees of freedom do not affect P

D It is exactly zero, whatever the chi-square value is

> **Answer 193: A**
>
> Correct. More categories allow more deviation by chance, so using too few degrees of freedom makes a given χ^2 look less likely than it is.

4. Interpreting the P value

Codex, slide 119 · Interpreting the P value · Easy

194. By convention, what P value is the standard cutoff for acceptable goodness of fit?

A 0.50

B 0.10

C 0.05

D 0.01

> **Answer 194: C**
>
> Correct. By convention 0.05 is the arbitrary standard.

Codex, slide 119-122 · Interpreting the P value · Easy

195. A geneticist tests a 3:1 hypothesis and obtains P = 0.31. What should be decided?

A Reject: the data do not fit the hypothesised ratio

B Accept: the data are consistent with the ratio

C Reject: a P this high is too large to be acceptable

D Accept: the hypothesis is therefore proven to be true

> **Answer 195: B**
>
> Correct. A P above 0.05 is acceptable.

Codex, slide 119-122 · Interpreting the P value · Easy

196. A 9:3:3:1 test returns P = 0.012. What is the right decision?

A Accept: the data fit the ratio well

B Accept: P is below 0.05, which is good

C Reject: the data do not fit the ratio

D Reject: P is above 0.05, which is poor

> **Answer 196: C**
>
> Correct. A P below 0.05 is unacceptable for goodness of fit.

Codex, slide 119-122 · Interpreting the P value · Medium

197. A 1:1 testcross test yields P = 0.07. What decision follows?

A Accept: P is above 0.05

B Reject: it is close to the cutoff

C Accept: P is below 0.05

D Reject: the sample was too large

> **Answer 197: A**
>
> Correct. All P values between 0.05 and 1.0 are acceptable.

Codex, slide 117-118 · Interpreting the P value · Hard

198. A dihybrid cross test gives P = 0.26. Which interpretation is correct?

A There is a 74% probability that the hypothesis is true

B 26% of the offspring deviated from the expected ratio

C The data are unacceptable because 0.26 is far from 1

D About a 26% chance that a deviation this large arose by chance

> **Answer 198: D**
>
> Correct. A P of 0.26 means about one chance in four that the deviation is due to chance.

Codex, slide 119-122 · Interpreting the P value · Hard

199. A chi-square test of a 9:3:3:1 hypothesis gives P = 0.04. What is the correct decision?

A Reject the hypothesised ratio, because P is below 0.05

B Accept the ratio, because P is close to zero

C Accept the ratio, because the sample is large

D Reject the ratio, because P is above 0.05

> **Answer 199: A**
>
> Correct. A P below 0.05 means the data do not fit the hypothesised ratio.

Codex, slides 119-122 · Interpreting the P value · Hard

200. Which statements about P values in chi-square analysis are correct?

1. By convention, 0.05 is the cutoff.

2. A P value below 0.05 means the data do not fit the hypothesised ratio.

3. A P value above 0.05 proves the hypothesis is true.

A 1, 2 and 3

B 1 and 3 only

C 1 and 2 only

D 2 and 3 only

> **Answer 200: C**
>
> Correct. Statements 1 and 2 match the lecture; an acceptable P shows consistency, not proof.

Codex, slide 119-122 · Interpreting the P value · Hard

201. A chi-square test of a 1:2:1 ratio gives P = 0.049. What is the correct decision?

A Accept: P is practically 0.05

B Accept: 0.049 rounds to 0.05

C Reject: P must exceed 0.5

D Reject: P is just below 0.05

> **Answer 201: D**
>
> Correct. Any value below 0.05 is unacceptable, even by a small margin.

Codex, slide 119 · Interpreting the P value · Hard

202. Why does the lecture describe 0.05 as an arbitrary standard?

A It is derived from the genotype ratio being tested

B It equals the 5% of offspring that always deviate

C It is a convention chosen by investigators, not a natural law

D It is fixed by the number of categories in the test

> **Answer 202: C**
>
> Correct. The decision depends on the investigator's certainty, and 0.05 is a convention.

Codex, slide 119-120 · Interpreting the P value · Hard

203. By convention, which range of P values is acceptable for goodness of fit?

A 0 to 0.05

B 0.05 to 1.0

C 0.5 to 1.0 only

D Exactly 0.05 only

> **Answer 203: B**
>
> Correct. All values between 0.05 and 1.0 are considered acceptable.

Codex, slide 119-122 · Interpreting the P value · Devil

204. What does P = 0.26 allow the geneticist to conclude about a 9:3:3:1 hypothesis?

A The data are consistent with it but not proven

B The hypothesis is thereby proven to be true

C The hypothesis must therefore be rejected outright

D The sample was too small to carry out the test

> **Answer 204: A**
>
> Correct. A P above 0.05 means consistency, not proof.

Codex, slide 110, 115; general · Interpreting the P value · Devil

205. Experiment 1 gives 740 dominant : 260 recessive against a 3:1 hypothesis ($\chi^2 \approx 0.53$). Experiment 2 has ten times the offspring with the same percentage split (7400 : 2600). What happens?

A χ^2 stays at about 0.53, so the 3:1 hypothesis is accepted

B χ^2 falls to about 0.05, so the 3:1 hypothesis is accepted

C χ^2 rises to about 5.3, yet the 3:1 hypothesis is still accepted

D χ^2 rises to about 5.3, P falls below 0.05, and the 3:1 ratio is rejected

> **Answer 205: D**
>
> Correct. Counts scale by ten, so χ^2 scales by ten to about 5.3, which is below P = 0.05 for one degree of freedom.

Codex, slides 119-122 · Interpreting the P value · Devil

206. Decide whether each result is acceptable for goodness of fit.
(i) P = 0.60
(ii) P = 0.03
(iii) P = 0.12

A (i) unacceptable; (ii) acceptable; (iii) unacceptable

B (i) acceptable; (ii) acceptable; (iii) unacceptable

C (i) unacceptable; (ii) unacceptable; (iii) acceptable

D (i) acceptable; (ii) unacceptable; (iii) acceptable

> **Answer 206: D**
>
> Correct. P = 0.60 and 0.12 are above 0.05 and acceptable; P = 0.03 is below 0.05 and unacceptable.

Codex, slide 119-121 · Interpreting the P value · Devil

207. A student finds P = 0.48 and says Mendel's ratio is proven. What is wrong with this?

A P = 0.48 is below the standard, so the ratio must be rejected

B A P that high means the sample was too small to test

C A P above 0.05 shows consistency with the ratio, not proof

D Only P = 1.0 would show that the data are consistent

> **Answer 207: C**
>
> Correct. The lecture says the data are consistent with the hypothesis, not proven.

Codex, slide 118 · Interpreting the P value · Devil

208. Which statement is the lecture's second interpretation of P = 0.26?

A 26% of the offspring are expected to show the dominant trait

B About 26% of repeated trials would show chance deviation this large

C The hypothesis is about 26% likely to be the true one

D The data are only about 26% accurate as measurements

> **Answer 208: B**
>
> Correct. The second interpretation is about repeated experiments showing chance deviation.

Codex, slide 121 · Interpreting the P value · Devil

209. A 9:3:3:1 test gives P = 0.26. What genetic model does the lecture say the data are consistent with?

A A one-locus model with incomplete dominance

B A three-locus model with no dominance

C A two-locus model with dominance at both

D A model in which the two genes are linked

> **Answer 209: C**
>
> Correct. The lecture links acceptable 9:3:3:1 data to two loci with dominance at each.

Codex, slide 119-122 · Interpreting the P value · Devil

210. A researcher gets P = 0.03 and says, "only a 3% deviation, so the data fit well." What is wrong with this?

A P is not a percentage deviation; below 0.05 is a poor fit

B A P below 0.05 means the data fit especially well

C P = 0.03 would be acceptable when there are many categories

D A 3% deviation always counts as mere chance deviation

> **Answer 210: A**
>
> Correct. P is a probability, and values below 0.05 are unacceptable.

Module 4: Gene interactions — 51 questions

1. Assumptions and conventions

Genetics 4-6, slide 5 · Assumptions and conventions · Easy

211. In the lecture's study of gene interactions, what is assumed about the genes in each cross?

A They are unlinked and assort independently during gamete formation

B They lie on the same chromosome and are always inherited together as one

C They are all codominant with each other in the heterozygote

D Each one controls a separate and unrelated trait in the cross

> **Answer 211: A**
>
> Correct. The first assumption is that the genes are unlinked and assort independently.

Genetics 4-6, slide 6 · Assumptions and conventions · Easy

212. What does the symbol A- mean in a genotype?

A Only the dominant allele, present in a single copy

B Only the recessive allele, in the homozygous state

C Either allele may be present, so it stands for AA or Aa

D A deleted or missing allele at that particular gene locus

> **Answer 212: C**
>
> Correct. The dash means either allele may be present without consequence.

Genetics 4-6, slide 7 · Assumptions and conventions · Medium

213. Which crosses are used for the P1 generation in the lecture's examples?

A Crosses between two double heterozygotes such as AaBb × AaBb

B Crosses between an AABB plant and a heterozygous AaBb plant

C Crosses in which every parent is heterozygous for just one of the two genes

D Crosses between homozygous individuals, such as AABB × aabb or AAbb × aaBB

> **Answer 213: D**
>
> Correct. The P1 crosses involve homozygous individuals.

Genetics 4-6, slide 7 · Assumptions and conventions · Medium

214. What is the F1 genotype when AABB is crossed with aabb?

A AaBb

B AABB

C aabb

D AaBB

Answer 214: A

Correct. Each parent supplies one allele of each gene, so the F1 is AaBb.

Genetics 4-6, slide 6 · Assumptions and conventions · Hard

215. Why can AA and Aa both be written as A- in these problems?

A Both genotypes always occur in exactly equal numbers among the progeny

B The recessive allele is completely absent from both genotypes

C Complete dominance makes the two genotypes equivalent in their effect

D Incomplete dominance makes the two genotypes look identical

Answer 215: C

Correct. With complete dominance the two genotypes have the same effect.

Genetics 4-6, slide 7 · Assumptions and conventions · Hard

216. What are the F1 plants of the cross AAbb × aaBB?

A Half AAbb and half aaBB

B All AABb

C A 1:1 mixture of Aabb and aaBb

D All AaBb heterozygotes

Answer 216: D

Correct. Each parent contributes one allele of each gene, giving AaBb.

Genetics 4-6, slide 8 · Assumptions and conventions · Hard

217. In the lecture's examples, which generation is the main focus of analysis?

A The P1 generation of homozygous parents

B The F1 generation of heterozygous hybrids

C The F2 produced from the heterozygous F1 parents

D The testcross generation derived from a recessive parent

Answer 217: C

Correct. The F2 shows the modified ratios the lecture analyses.

Genetics 4-6, slide 10 · Assumptions and conventions · Devil

218. Why do the F2 genotypes of a two-gene cross fall into just four categories in these problems?

A Dominance groups AA/Aa and BB/Bb as A- and B-, leaving four classes

B Only four gamete types exist in the F1 parent plants

C The two genes are linked on the same chromosome pair

D Epistasis removes five of the nine possible genotypes before the plants are counted

Answer 218: A

Correct. Grouping by dominance gives 9/16, 3/16, 3/16 and 1/16.

2. Epistasis: the basic idea

Genetics 4-6, slide 12 · Epistasis: the basic idea · Easy

219. What is epistasis?

A Two alleles of one gene both being fully expressed in the heterozygote

B One allele of a gene dominating the other allele at the same locus

C Two genes lying close together on the same chromosome

D A gene masking the expression of a non-allelic gene at another locus

> **Answer 219: D**
>
> Correct. Epistasis is an interaction between different genes.

Genetics 4-6, slide 13 · Epistasis: the basic idea · Medium

220. In epistasis, what is the gene that is masked called?

A The hypostatic gene

B The epistatic gene

C The dominant gene

D The recessive gene

> **Answer 220: A**
>
> Correct. The suppressed gene is hypostatic.

Genetics 4-6, slide 14 · Epistasis: the basic idea · Medium

221. Which statement correctly separates epistasis from dominance?

A Epistasis acts between alleles of one gene, while dominance acts between different genes

B They are the same process under two different names

C Dominance needs two loci, whereas epistasis needs only one locus

D Epistasis acts between different genes, dominance between alleles of one gene

> **Answer 221: D**
>
> Correct. The lecture says epistasis involves non-alleles and dominance involves alleles.

Genetics 4-6, slide 16 · Epistasis: the basic idea · Hard

222. When epistasis operates between two loci, how many phenotypes appear among offspring of dihybrid parents?

A Exactly four

B Fewer than four

C More than four

D Exactly nine

> **Answer 222: B**
>
> Correct. Epistasis reduces the number of phenotypes below four.

Genetics 4-6, slide 16 · Epistasis: the basic idea · Hard

223. How many types of epistatic ratio does the lecture recognise, and how are they divided?

A Four: two with three phenotypes and two with only two phenotypes

B Six: all of them with three distinct phenotypes each

C Six: three with three phenotypes and three with two phenotypes

D Three: all of them with only two phenotypes each

> **Answer 223: C**
>
> Correct. Six types, half with three phenotypes and half with two.

Genetics 4-6, slide 15 · Epistasis: the basic idea · Hard

224. Which is a way epistasis can show up, according to the lecture?

A Two alleles of one gene blending in the heterozygote

B A whole gene moving to another chromosome in the cell

C The homozygous recessive state of one gene blocking a different gene

D A recessive allele masking its own dominant allele at the same locus

> **Answer 224: C**
>
> Correct. A homozygous recessive genotype can block a different gene.

Genetics 4-6, slide 13 · Epistasis: the basic idea · Hard

225. Gene X masks the expression of gene Y. Which statement is correct?

A Y is epistatic to X, and X is hypostatic to Y

B Both genes are epistatic to each other

C Both genes are hypostatic

D X is epistatic to Y, and Y is hypostatic to X

> **Answer 225: D**
>
> Correct. The masking gene is epistatic and the masked gene is hypostatic.

Genetics 4-6, slide 14 · Epistasis: the basic idea · Devil

226. A student says epistasis is just very strong dominance. What is the best correction?

A Dominance is between alleles of one gene; epistasis is between different genes

B Epistasis is simply dominance that occurs only in homozygous individuals

C Dominance requires two different genes to interact with each other

D Epistasis acts only on recessive alleles of a single gene

> **Answer 226: A**
>
> Correct. The lecture says epistasis should not be confused with dominance.

Genetics 4-6, slide 4 · Epistasis: the basic idea · Devil

227. Does gene interaction require the products of different genes to interact directly with each other?

A Yes; the gene products must bind directly to each other in the cell

B No; the combined function of many gene products contributes to one phenotype

C Yes; the genes must lie on the same chromosome of the pair

D No; gene interaction simply means the genes are physically linked

> **Answer 227: B**
>
> Correct. The lecture says interaction does not necessarily mean direct contact.

Genetics 4-6, slide 16 · Epistasis: the basic idea · Devil

228. Which observation would point to epistasis rather than ordinary independent assortment in a dihybrid F2?

A Fewer than four phenotypic classes, with ratio parts summing to 16

B Exactly nine genotypes among the F2 plants

C Four phenotypic classes in a 9:3:3:1 ratio of the F2

D All of the offspring resembling the dominant parent in the F1 and F2

> **Answer 228: A**
>
> Correct. Modified ratios such as 12:3:1, 9:3:4 and 9:7 still sum to 16.

3. Dominant epistasis (12:3:1)

Genetics 4-6, slide 20 · Dominant epistasis (12:3:1) · Easy

229. What F2 ratio is produced by dominant epistasis?

A 9:3:4

B 9:7

C 12:3:1

D 9:3:3:1

> **Answer 229: C**
>
> Correct. Dominant epistasis modifies 9:3:3:1 into 12:3:1.

Genetics 4-6, slide 19 · Dominant epistasis (12:3:1) · Medium

230. Under dominant epistasis by the A locus, which genotype at the epistatic locus lets the alleles of the B locus be expressed?

A AA

B Aa

C A-

D aa

> **Answer 230: D**
>
> Correct. Only the homozygous recessive aa lets B or b show.

Genetics 4-6, slide 20 · Dominant epistasis (12:3:1) · Medium

231. Under dominant epistasis by the A locus, which genotypes give the same phenotype?

A aaB- and aabb

B A-B- and A-bb

C A-B- and aabb

D A-bb and aaB-

> **Answer 231: B**
>
> Correct. The dominant A allele gives one phenotype whatever the B locus carries.

Genetics 4-6, slide 20 · Dominant epistasis (12:3:1) · Hard

232. How many phenotypes appear under dominant epistasis, and in what proportions?

A Three phenotypes in a 12:3:1 ratio

B Two phenotypes in a 13:3 ratio

C Three phenotypes in a 9:3:4 ratio

D Four phenotypes in a 9:3:3:1 ratio

> **Answer 232: A**
>
> Correct. A-B- and A-bb combine to 12, leaving 3 and 1.

Genetics 4-6, slide 20 · Dominant epistasis (12:3:1) · Hard

233. Of 320 F2 offspring showing dominant epistasis (12:3:1), how many are expected in the largest class?

A 180

B 60

C 80

D 240

> **Answer 233: D**
>
> Correct. 12/16 of 320 is 240.

Genetics 4-6, slide 20 · Dominant epistasis (12:3:1) · Hard

234. In the 12:3:1 ratio from dominant epistasis by A, which genotypes form the "3" class and which the "1" class?

A "3": A-bb; "1": aaB-

B "3": aabb; "1": A-B-

C "3": aaB-; "1": aabb

D "3": A-bb; "1": aabb

> **Answer 234: C**
>
> Correct. A- masks the B locus, so aaB- and aabb are the two remaining classes.

Genetics 4-6, slide 19 · Dominant epistasis (12:3:1) · Devil

235. A plant of genotype Aabb is produced in a cross with dominant epistasis of A. To which phenotype class does it belong?

A The class containing the aaB- plants

B The same class as A-B-, the largest class

C The class containing the aabb plants

D A fourth class that is separate from the rest

> **Answer 235: B**
>
> Correct. Any A- plant shows the epistatic phenotype regardless of B.

Genetics 4-6, slide 19 · Dominant epistasis (12:3:1) · Devil

236. Under dominant epistasis by A, what fraction of the F2 is aa, and how does it divide?

A One quarter are aa, and all of them show the same phenotype

B Three quarters are aa: half of them aaB- and half aabb

C One sixteenth are aa, and all of those plants are aabb

D One quarter are aa: three quarters aaB-, one quarter aabb

> **Answer 236: D**
>
> Correct. aa is 4/16, made of 3/16 aaB- and 1/16 aabb.

Genetics 4-6, slide 20 · Dominant epistasis (12:3:1) · Devil

237. Which two classes of a 9:3:3:1 data set would you merge to obtain a 12:3:1 ratio with A as the epistatic locus?

A aaB- and aabb

B A-B- and aaB-

C A-B- and A-bb

D A-bb and aabb

> **Answer 237: C**
>
> Correct. 9 + 3 = 12, merging A-B- and A-bb.

4. Recessive epistasis (9:3:4)

Genetics 4-6, slide 21 · Recessive epistasis (9:3:4) · Medium

238. What F2 ratio results from recessive epistasis?

A 9:3:4

B 12:3:1

C 9:7

D 15:1

> **Answer 238: A**
>
> Correct. Recessive epistasis modifies 9:3:3:1 into 9:3:4.

Genetics 4-6, slide 21 · Recessive epistasis (9:3:4) · Medium

239. Under recessive epistasis by aa, when can the alleles of the B locus be expressed?

A Only when the plant's genotype is homozygous aa

B Only when at least one dominant A allele is present

C Only when the plant's genotype is homozygous AA

D Only when the plant's genotype is the double recessive aabb

> **Answer 239: B**
>
> Correct. A dominant allele at the A locus is needed for B or b to show.

Genetics 4-6, slide 22 · Recessive epistasis (9:3:4) · Medium

240. In the 9:3:4 ratio from recessive epistasis by aa, which genotypes share the "4" class?

A A-bb and aabb

B A-B- and aaB-

C aaB- and aabb

D A-B- and A-bb

> **Answer 240: C**
>
> Correct. aa masks the B locus, so aaB- and aabb look alike.

Genetics 4-6, slide 22 · Recessive epistasis (9:3:4) · Hard

241. Of 480 F2 offspring showing recessive epistasis (9:3:4), how many are expected in the largest class?

A 270

B 90

C 120

D 360

> **Answer 241: A**
>
> Correct. 9/16 of 480 is 270.

Genetics 4-6, slide 22 · Recessive epistasis (9:3:4) · Hard

242. Of 320 F2 offspring showing 9:3:4, how many are expected in the combined "4" class?

A 20

B 60

C 180

D 80

> **Answer 242: D**
>
> Correct. 4/16 of 320 is 80.

Genetics 4-6, slide 22 · Recessive epistasis (9:3:4) · Hard

243. Under recessive epistasis by aa, which genotype classes give the "9" and "3" phenotypes?

A A-B- gives the 3 and A-bb gives the 9

B A-B- gives the 9 and A-bb gives the 3

C aaB- gives the 9 and aabb gives the 3

D A-B- and A-bb both give the 9

> **Answer 243: B**
>
> Correct. These two classes keep their own phenotypes.

Genetics 4-6, slide 21 · Recessive epistasis (9:3:4) · Devil

244. A plant of genotype aaBb is in a cross with recessive epistasis by aa. What is its phenotype class?

A The "9" class, with A-B- plants

B The "4" class, together with aaBB and aabb

C The "3" class, with A-bb plants

D A fifth class that is separate from all the others

> **Answer 244: B**
>
> Correct. Any aa plant has the masked phenotype.

Genetics 4-6, slide 21 · Recessive epistasis (9:3:4) · Devil

245. How does a 9:3:4 ratio differ in cause from a 12:3:1 ratio?

A In 9:3:4 a dominant allele masks B, but in 12:3:1 aa masks B

B They differ only because 9:3:4 requires the genes to be linked

C They differ because 12:3:1 involves no epistasis at all, whereas 9:3:4 involves strong linkage

D In 9:3:4 the recessive genotype aa masks B; in 12:3:1 a dominant allele A masks B

> **Answer 245: D**
>
> Correct. Recessive versus dominant epistasis is the difference.

Genetics 4-6, slide 22 · Recessive epistasis (9:3:4) · Devil

246. An F2 of 160 plants gives 90 : 30 : 40. Which interpretation fits best?

A Recessive epistasis, with expected 90:30:40

B Dominant epistasis, with expected 120:30:10

C Duplicative recessive genes, with expected 90:70

D Independent assortment, with expected 90:30:30:10

> **Answer 246: A**
>
> Correct. 160 × 9/16, 3/16 and 4/16 gives exactly 90, 30 and 40.

5. Duplicative recessive genes (9:7)

Genetics 4-6, slide 27 · Duplicative recessive genes (9:7) · Easy

247. What F2 ratio is produced by duplicative recessive genes?

A 12:3:1

B 9:3:4

C 9:7

D 3:1

> **Answer 247: C**
>
> Correct. Both homozygous recessive genotypes give the same phenotype, giving 9:7.

Genetics 4-6, slide 27 · Duplicative recessive genes (9:7) · Medium

248. Under duplicative recessive genes, which genotypes give the same phenotype?

A A-B-, A-bb and aabb

B A-B- and aaB-

C aaB-, A-bb and aabb

D aaB- only

> **Answer 248: C**
>
> Correct. These three classes form the "7".

Genetics 4-6, slide 27 · Duplicative recessive genes (9:7) · Medium

249. How many phenotypes appear in a 9:7 ratio?

A Two

B Three

C Four

D One

> **Answer 249: A**
>
> Correct. A-B- is one phenotype and the other classes form the second.

Genetics 4-6, slide 27 · Duplicative recessive genes (9:7) · Hard

250. Why do all genotypes lacking a dominant allele at either locus give one phenotype in a 9:7 ratio?

A Both loci are linked, so recessive alleles are lost from the gametes

B Only aabb gives the recessive phenotype; the rest give the dominant one

C A single dominant allele at either locus alone is enough to give the other phenotype

D A recessive genotype at either locus gives one phenotype; only A-B- gives the other

> **Answer 250: D**
>
> Correct. Both dominant alleles must be present together for the different phenotype.

Genetics 4-6, slide 27 · Duplicative recessive genes (9:7) · Hard

251. Of 320 F2 plants showing duplicative recessive genes (9:7), how many are expected to show the "7" phenotype?

A 80

B 140

C 180

D 100

> **Answer 251: B**
>
> Correct. 7/16 of 320 is 140.

Genetics 4-6, slide 27 · Duplicative recessive genes (9:7) · Hard

252. Which single genotype class forms the "9" in a 9:7 ratio?

A A-B-

B A-bb

C aaB-

D aabb

> **Answer 252: A**
>
> Correct. Only plants with both dominant alleles show the "9" phenotype.

Genetics 4-6, slide 32 · Duplicative recessive genes (9:7) · Devil

253. Two pure lines share the same phenotype but their cross gives an F1 with a new phenotype. Which gene interaction fits best?

A Dominant epistasis, with a dominant allele in one parent masking the other gene

B Duplicative recessive genes, the parents being recessive at different loci

C Recessive epistasis, with both parents carrying A- alleles

D Independent assortment, giving a 9:3:3:1 ratio in the F2

> **Answer 253: B**
>
> Correct. Complementing dominant alleles in the F1 give the new phenotype.

Genetics 4-6, slide 27 · Duplicative recessive genes (9:7) · Devil

254. How many genotype categories form the "7" class in a 9:7 ratio, and what is their total probability?

A Two categories (A-bb, aabb), totalling 7/16

B Three categories (aaB-, A-bb, aabb), totalling 9/16 of the F2

C Four categories (A-B-, aaB-, A-bb, aabb), totalling 7/16

D Three categories (aaB-, A-bb, aabb), totalling 7/16

> **Answer 254: D**
>
> Correct. 3/16 + 3/16 + 1/16 = 7/16.

6. Solved problem: sweet pea flowers

Genetics 4-6, slide 28 · Solved problem: sweet pea flowers · Medium

255. Two white-flowered sweet pea strains give an F1 with only purple flowers. What does this show?

A Purple is recessive to white in the sweet pea, so the F1 looks purple

B Both of the white parents were heterozygous (AaBb)

C The two white strains carry different recessive genes that complement

D The F1 plants inherited only the white alleles from both parents

> **Answer 255: C**
>
> Correct. Each white strain is recessive at a different locus.

Genetics 4-6, slide 30 · Solved problem: sweet pea flowers · Medium

256. In the sweet pea problem the F2 had 53 purple and 43 white plants among 96. Which ratio is closest?

A 9:7

B 3:1

C 1:1

D 12:3:1

> **Answer 256: A**
>
> Correct. About 8.8 : 7.2 sixteenths, which is near 9:7.

Genetics 4-6, slide 30 · Solved problem: sweet pea flowers · Hard

257. Using 43/96 = x/16, what is x for the white flowers?

A About 8.8

B About 3.0

C About 12.0

D About 7.2

> **Answer 257: D**
>
> Correct. $43/96 \times 16 \approx 7.2$.

Genetics 4-6, slide 30 · Solved problem: sweet pea flowers · Hard

258. Using 53/96 = x/16, what is x for the purple flowers?

A About 7.2

B About 8.8

C About 9.6

D About 4.8

> **Answer 258: B**
>
> Correct. $53/96 \times 16 \approx 8.8$.

Genetics 4-6, slide 32 · Solved problem: sweet pea flowers · Hard

259. What were the probable genotypes of the two white parental sweet pea strains?

A AABB × aabb

B AaBb × AaBb

C aaBB × AAbb

D aabb × aabb

> **Answer 259: C**
>
> Correct. Different homozygous recessive combinations give an all-purple F1.

Genetics 4-6, slide 32 · Solved problem: sweet pea flowers · Hard

260. In the sweet pea cross, which F2 genotypes give white flowers?

A aaB-, A-bb and aabb

B A-B- only

C aaBB only

D A-B- and aabb

> **Answer 260: A**
>
> Correct. Any plant lacking a dominant allele at either locus is white.

Genetics 4-6, slide 32 · Solved problem: sweet pea flowers · Devil

261. If one white parent in the sweet pea cross had been aabb, what would the F1 colour be?

A Purple, because every F1 plant is heterozygous at both loci and so dominant

B Purple, because the aabb genotype is dominant over all

C A mixture of purple and white, in a 1:1 ratio

D White, because the cross cannot supply dominant alleles at both loci

> **Answer 261: D**
>
> Correct. An F1 from aabb × AAbb is Aabb and lacks a B allele, so it is white.

Module 5: Cellular basis of inheritance — 110 questions

1. Chromosomes and chromatin

Genetics 4-6, slide 36 · Chromosomes and chromatin · Easy

262. How does the lecture describe a chromosome?

A A round organelle found in the cytoplasm that makes proteins for the cell

B A double membrane that surrounds and encloses the nucleus

C A thread-like entity of nucleic acid that carries genetic information

D A pair of centrioles in the cytoplasm near the nucleus

> **Answer 262: C**
>
> Correct. A chromosome is a thread-like entity composed of nucleic acid.

Genetics 4-6, slide 41 · Chromosomes and chromatin · Easy

263. How many chromosomes does a normal human somatic cell contain?

A 23

B 46

C 44

D 92

> **Answer 263: B**
>
> Correct. Human somatic cells are diploid with 46 chromosomes.

Genetics 4-6, slide 39 · Chromosomes and chromatin · Easy

264. What name is given to cells with half the number of chromosome sets found in somatic cells?

A Diploid (2n)

B Haploid (n)

C Triploid (3n)

D Polyploid

> **Answer 264: B**
>
> Correct. Gametes are haploid cells.

Genetics 4-6, slide 41 · Chromosomes and chromatin · Medium

265. How are human chromosomes divided into autosomes and sex chromosomes?

A 23 pairs of autosomes and no sex chromosomes

B 21 pairs of autosomes and two pairs of sex chromosomes

C 22 pairs of autosomes and one pair of sex chromosomes

D 44 pairs of autosomes and one sex chromosome

> **Answer 265: C**
> Correct. 22 autosome pairs plus the sex chromosome pair give 46.

Genetics 4-6, slide 42 · Chromosomes and chromatin · Medium

266. What is chromatin?

A The complex of DNA and protein that forms chromosomes
B The double membrane that surrounds the nucleus
C A spindle fibre made of microtubules and motor proteins
D The constricted region of a chromosome that holds chromatids

> **Answer 266: A**
> Correct. Chromatin is the nucleoprotein material of the chromosome.

Genetics 4-6, slide 43 · Chromosomes and chromatin · Medium

267. What do histones do in a chromosome?

A They copy the DNA of each chromosome during S phase
B They move the chromosomes along the spindle fibres
C They cut the sister chromatids apart at the start of anaphase
D They help organise the long DNA strands into nucleosomes

> **Answer 267: D**
> Correct. Histones organise DNA into nucleosome structures.

Genetics 4-6, slide 47 · Chromosomes and chromatin · Medium

268. Which arm of a chromosome is called the p arm?

A The longer arm
B The shorter arm
C The arm closest to the telomere only
D The arm that carries the centromere

> **Answer 268: B**
> Correct. The shorter arm is p and the longer is q.

Genetics 4-6, slide 40 · Chromosomes and chromatin · Medium

269. A garden pea has 14 somatic chromosomes. How many chromosomes does one of its gametes carry?

A 14
B 28
C 3
D 7

> **Answer 269: D**
> Correct. A gamete is haploid, so 14/2 = 7.

Genetics 4-6, slide 37 · Chromosomes and chromatin · Hard

270. A human somatic cell has 46 chromosomes. How many came from each parent?

A 23 from each parent

B 46 from the mother

C 23 from the mother and 23 from nobody

D 44 from the mother and 2 from the father

> **Answer 270: A**
>
> Correct. One set comes from each parent, so 23 each.

Genetics 4-6, slide 45 · Chromosomes and chromatin · Hard

271. Which two criteria are listed for distinguishing chromosomes from one another?

A The colour and the shape of the cell nucleus

B The number of mitochondria and ribosomes in the cell

C Relative length and the position of the centromere

D The number of cell divisions the cell has completed

> **Answer 271: C**
>
> Correct. Length and centromere position are the criteria.

Genetics 4-6, slide 46 · Chromosomes and chromatin · Hard

272. Which of these is NOT a chromosome type named by centromere position in the lecture?

A Metacentric

B Polycentric

C Acrocentric

D Telocentric

> **Answer 272: B**
>
> Correct. The lecture names metacentric, submetacentric, acrocentric, telocentric and subtelocentric.

Genetics 4-6, slide 40 · Chromosomes and chromatin · Hard

273. Why do all somatic cells of a species have the same chromosome number?

A The somatic chromosome number is characteristic of the species

B Chromosome number depends on the age and the sex of the individual

C Each tissue of the body keeps a different number

D Gametes keep the full somatic number of the species

> **Answer 273: A**
>
> Correct. The number in each somatic cell is the same for all members of a species.

Genetics 4-6, slide 40 · Chromosomes and chromatin · Hard

274. Cattle have 60 somatic chromosomes. How many does a sperm cell carry?

A 60

B 15

C 30

D 120

> **Answer 274: C**
>
> Correct. A gamete carries half the somatic number.

Genetics 4-6, slide 40 · Chromosomes and chromatin · Hard

275. Which species and somatic chromosome number pair is correct, according to the lecture?

A Human: 48

B Garden pea: 24

C Cattle: 46

D Cattle: 60

> **Answer 275: D**
>
> Correct. The lecture gives human 46, garden pea 14 and cattle 60.

Genetics 4-6, slide 39 · Chromosomes and chromatin · Devil

276. A cell has 14 chromosomes and is described as 2n. What are n and the number carried by each gamete?

A n = 14; each gamete carries 14 chromosomes

B n = 7; each gamete carries 7 chromosomes

C n = 28; each gamete carries 14 chromosomes

D n = 7; each gamete carries 14 chromosomes

> **Answer 276: B**
>
> Correct. 2n = 14 gives n = 7, and gametes carry n.

Genetics 4-6, slide 47 · Chromosomes and chromatin · Devil

277. How does the lecture define autosomes?

A All chromosomes except the sex chromosomes

B The chromosomes that determine sex

C Only the shortest chromosomes

D The chromosomes found only in gametes

> **Answer 277: A**
>
> Correct. Autosomes exclude the sex chromosomes.

Genetics 4-6, slide 40 · Chromosomes and chromatin · Devil

278. An organism has 2n = 60, including one pair of sex chromosomes. How many autosomes does a somatic cell contain?

A 59
B 60
C 58
D 30

> **Answer 278: C**
> Correct. 60 minus the two sex chromosomes leaves 58 autosomes.

Genetics 4-6, slide 37 · Chromosomes and chromatin · Devil

279. Why are the two chromosomes of a homologous pair called homologues?

A Both of the chromosomes came from the very same single parent of the cell
B They are identical sister chromatids of one chromosome
C They are non-comparable chromosomes from different species
D One came from the maternal parent and one from the paternal parent

> **Answer 279: D**
> Correct. A homologous pair is one maternal and one paternal chromosome.

2. Cell cycle and interphase

Genetics 4-6, slide 52 · Cell cycle and interphase · Easy

280. What are the three phases of interphase?

A G1, S and G2
B G1, M and G2
C Prophase, metaphase and anaphase
D S, M and cytokinesis

> **Answer 280: A**
> Correct. Interphase consists of G1, S and G2.

Genetics 4-6, slide 53 · Cell cycle and interphase · Easy

281. In which phase of interphase are chromosomes replicated?

A G1 phase
B G2 phase
C M phase
D S phase

> **Answer 281: D**
> Correct. Chromosomes are copied only during S phase.

Genetics 4-6, slide 55 · Cell cycle and interphase · Medium

282. What are "sister chromatids"?

A The two homologous chromosomes inherited from the mother and the father

B The identical DNA molecules produced when a chromosome is replicated

C Two different chromosomes that came from different parents

D Two centrioles found together in an animal cell

> **Answer 282: B**
>
> Correct. Replication gives an identical pair of chromatids.

Genetics 4-6, slide 56 · Cell cycle and interphase · Medium

283. What is the cell doing in G1?

A Dividing its cytoplasm

B Separating sister chromatids

C Preparing for DNA synthesis

D Forming the cell plate

> **Answer 283: C**
>
> Correct. G1 prepares the cell for DNA synthesis.

Genetics 4-6, slide 56 · Cell cycle and interphase · Medium

284. What begins to happen to chromosomes during G2?

A They are replicated for the first time

B They begin to condense into compact bodies

C They move to the spindle poles

D They are separated into daughter cells

> **Answer 284: B**
>
> Correct. Condensation begins in G2.

Genetics 4-6, slide 58 · Cell cycle and interphase · Medium

285. Which phase of the cell cycle is the shortest?

A Mitosis

B G1

C S

D G2

> **Answer 285: A**
>
> Correct. Mitosis takes about one hour of an 18 to 24 hour cycle.

Genetics 4-6, slide 58 · Cell cycle and interphase · Hard

286. In an ideal animal cell with an 18 to 24 hour cycle, about how long does mitosis take?

A About 6 hours

B About 12 hours

C About 1 hour

D About 18 hours

> **Answer 286: C**
>
> Correct. The lecture gives about one hour.

Genetics 4-6, slide 58 · Cell cycle and interphase · Hard

287. With G1 at 6 to 12 h, S at 6 to 8 h and G2 at 3 to 4 h, what is the shortest total interphase?

A 12 hours

B 24 hours

C 18 hours

D 15 hours

> **Answer 287: D**
>
> Correct. 6 + 6 + 3 = 15 hours.

Genetics 4-6, slide 58 · Cell cycle and interphase · Hard

288. With G1 at 6 to 12 h, S at 6 to 8 h and G2 at 3 to 4 h, what is the longest total interphase?

A 24 hours

B 15 hours

C 18 hours

D 21 hours

> **Answer 288: A**
>
> Correct. 12 + 8 + 4 = 24 hours.

Genetics 4-6, slide 58 · Cell cycle and interphase · Hard

289. In a 24 hour cell cycle with a 1 hour mitosis, what share of the cycle is interphase?

A About 4%

B About 50%

C About 96%

D About 75%

> **Answer 289: C**
>
> Correct. 23/24 is about 96%.

Genetics 4-6, slide 57 · Cell cycle and interphase · Hard

290. Why are interphase chromosomes not visible under the light microscope?

A They are absent from the nucleus

B They are replaced by spindle fibres

C They are hidden inside the centrioles

D They are not yet condensed

> **Answer 290: D**
>
> Correct. Interphase is the part of the cell cycle in which condensed chromosomes are not visible.

Genetics 4-6, slide 56 · Cell cycle and interphase · Hard

291. Once a cell enters G1 of the cell cycle, what is it committed to?

A Dying

B Completing the cycle

C Becoming haploid

D Skipping S phase

> **Answer 291: B**
>
> Correct. The lecture says it is committed to completing the cycle.

Genetics 4-6, slide 55 · Cell cycle and interphase · Hard

292. How many DNA molecules does a replicated chromosome carry as it enters mitosis?

A One DNA molecule

B Four DNA molecules

C Two identical DNA molecules

D Three DNA molecules

> **Answer 292: C**
>
> Correct. Each replicated chromosome has two identical sister chromatids.

Genetics 4-6, slide 56 · Cell cycle and interphase · Hard

293. What happens in the G2 phase?

A The chromosomes are replicated for the very first time in the cell cycle

B The chromosomes begin to condense as the cell prepares for mitosis

C Sister chromatids separate and move to the poles

D Homologous chromosomes pair up and exchange segments

> **Answer 293: B**
>
> Correct. G2 prepares the cell for mitosis.

Genetics 4-6, slide 55 · Cell cycle and interphase · Devil

294. A human cell has 46 chromosomes in G1. How many chromatids does it contain just after S phase?

A 92
B 46
C 23
D 184

> **Answer 294: A**
> Correct. Each of 46 chromosomes now has two sister chromatids, giving 92.

Genetics 4-6, slide 55 · Cell cycle and interphase · Devil

295. A student says the chromosome number doubles in S phase. What is the correct statement?

A The chromosome number doubles and the DNA stays the same
B Both the chromosome number and the DNA are halved
C Chromosome number doubles because the nucleus divides
D The DNA content doubles, but the chromosome number stays the same

> **Answer 295: D**
> Correct. Replication gives sister chromatids, but each is still part of one chromosome.

Genetics 4-6, slide 54 · Cell cycle and interphase · Devil

296. Why does a cell spend most of its life in interphase?

A Interphase is the only phase of the cycle in which cells divide
B Cells cannot enter mitosis more than once in their life
C Mitosis is short, about an hour of an 18 to 24 hour cycle
D The cell cycle consists only of the G1 phase and nothing else

> **Answer 296: C**
> Correct. Mitosis is the shortest phase.

slides 53-58 · Cell cycle and interphase · Devil

297. Which statements about interphase are correct?
1. Chromosomes are replicated only in S phase.
2. Condensed chromosomes are clearly visible under the light microscope.
3. A cell spends most of its life in interphase.

A 1, 2 and 3
B 1 and 3 only
C 2 and 3 only
D 1 and 2 only

> **Answer 297: B**
> Correct. Replication is limited to S phase and most of the cell's life is interphase.

3. Mitosis

Genetics 4-6, slide 48 · Mitosis · Easy

298. One cell divides by mitosis. How many daughter cells result?

A One

B Three

C Four

D Two

> **Answer 298: D**
>
> Correct. Mitosis gives two daughter cells with identical chromosome sets.

Genetics 4-6, slide 51 · Mitosis · Easy

299. What is the correct order of the four stages of mitosis?

A Metaphase, prophase, anaphase, telophase

B Prophase, metaphase, anaphase, telophase

C Prophase, anaphase, metaphase, telophase

D Telophase, prophase, metaphase, anaphase

> **Answer 299: B**
>
> Correct. The four stages run P, M, A, T.

Genetics 4-6, slide 64 · Mitosis · Medium

300. Which stage of mitosis is marked by chromosome condensation and the breakdown of the nuclear envelope?

A Prophase

B Metaphase

C Anaphase

D Telophase

> **Answer 300: A**
>
> Correct. Prophase condenses chromosomes and breaks down the envelope.

Genetics 4-6, slide 65 · Mitosis · Medium

301. At which stage do sister chromatids align at the spindle equator?

A Metaphase

B Prophase

C Anaphase

D Telophase

> **Answer 301: A**
>
> Correct. Metaphase begins when sister chromatids align at the equator.

Genetics 4-6, slide 66 · Mitosis · Medium

302. At which stage do sister chromatids separate at the centromere?

A Prophase

B Anaphase

C Metaphase

D Telophase

> **Answer 302: B**
>
> Correct. Sister chromatids separate during anaphase.

Genetics 4-6, slide 69 · Mitosis · Medium

303. What happens in telophase?

A Chromosomes condense and the nucleolus disappears

B Chromosomes align at the equator of the spindle

C Nuclear membranes reform and the nucleolus reappears

D Sister chromatids separate and move to opposite poles

> **Answer 303: C**
>
> Correct. Telophase reverses prophase events.

Genetics 4-6, slide 71 · Mitosis · Medium

304. What is cytokinesis?

A The replication of the DNA of every chromosome in the cell

B The pairing of homologous chromosomes in prophase I

C The condensation of chromosomes into compact bodies

D The physical division of the cytoplasm into two cells

> **Answer 304: D**
>
> Correct. Cytokinesis divides the cytoplasm.

Genetics 4-6, slide 71 · Mitosis · Medium

305. How does cytokinesis in plant cells differ from that in animal cells?

A Plant cells pinch in two, while animal cells form a cell plate

B Neither plant nor animal cells actually divide their cytoplasm

C Plant cells need centrioles to divide, while animal cells do not

D Plant cells form a cell plate, while animal cells pinch in two

> **Answer 305: D**
>
> Correct. Rigid cell walls mean plants form a partition between daughter cells.

Genetics 4-6, slide 59 · Mitosis · Hard

306. Which cells do not contain centrioles?

A Plant cells

B Animal cells

C Cells in prophase

D Cells in telophase

> **Answer 306: A**
>
> Correct. The lecture notes that plant cells do not contain centrioles.

Genetics 4-6, slide 63 · Mitosis · Hard

307. Why is late prophase the best time to study and count chromosomes?

A Chromosomes have already separated and formed two daughter nuclei

B The spindle has already disappeared from the cell

C Chromosomes are highly condensed and free of the nuclear membrane

D The chromosomes are not yet replicated at that point

> **Answer 307: C**
>
> Correct. Condensed chromosomes outside a nuclear membrane are easiest to count.

Genetics 4-6, slide 63 · Mitosis · Hard

308. What does colchicine do to a dividing cell?

A It prevents the DNA from replicating during S phase of interphase

B It blocks spindle fibre assembly, so mitosis stops before metaphase

C It dissolves the cell wall that surrounds each plant cell

D It makes the sister chromatids separate earlier than normal

> **Answer 308: B**
>
> Correct. Blocking the spindle arrests mitosis before metaphase.

Genetics 4-6, slide 67 · Mitosis · Hard

309. What shape do metacentric chromosomes appear to have when moving in anaphase?

A J-shaped

B V-shaped

C Rod-shaped

D Ring-shaped

> **Answer 309: B**
>
> Correct. Metacentric chromosomes appear V-shaped.

Genetics 4-6, slide 67 · Mitosis · Hard

310. What shape do submetacentric chromosomes appear to have in anaphase?

A V-shaped

B Rod-shaped

C Straight and unbent

D J-shaped

> **Answer 310: D**
>
> Correct. Submetacentric chromosomes appear J-shaped.

Genetics 4-6, slide 65 · Mitosis · Hard

311. What holds sister chromatids together until the beginning of anaphase?

A The centromere

B The cell plate

C The nucleolus

D The centrioles

> **Answer 311: A**
>
> Correct. The centromere holds the chromatids together.

Genetics 4-6, slide 50 · Mitosis · Hard

312. What are the two end results of mitosis, according to the lecture?

A Halving of the chromosome number, and the formation of four haploid cells

B Pairing of homologues, and the exchange of chromosome segments

C An exact copy of each chromosome, and an identical set for each daughter cell

D Fusion of two cells into one, and a doubled chromosome number

> **Answer 312: C**
>
> Correct. Mitosis copies and then distributes identical chromosome sets.

Genetics 4-6, slide 48 · Mitosis · Hard

313. What does it mean that mitosis is a "non-reductional" division?

A The cell loses half of its chromosomes and makes four daughter cells

B The cell makes four genetically different daughter cells

C The daughter cells keep the same chromosome number as the parent cell

D The chromosome number triples in each daughter cell

> **Answer 313: C**
>
> Correct. Mitosis does not reduce the chromosome number.

Genetics 4-6, slide 59 · Mitosis · Hard

314. In animal cells, which organelles initiate and organise the mitotic apparatus?

A Centrioles

B Ribosomes

C Mitochondria

D Lysosomes

> **Answer 314: A**
>
> Correct. Centrioles form asters and spindle fibres.

Genetics 4-6, slide 62 · Mitosis · Hard

315. What happens to the nuclear membrane and nucleolus by late prophase?

A Both double in size

B Both disappear

C Both move to the poles intact

D Both form around each chromosome

> **Answer 315: B**
>
> Correct. The nuclear membrane and nucleolus disappear by late prophase.

Genetics 4-6, slide 63 · Mitosis · Devil

316. A culture is treated with colchicine and examined. At which point do the cells accumulate?

A After telophase, with two daughter nuclei and divided cytoplasm in each

B In S phase, with DNA actively replicating in the cell

C In anaphase, with sister chromatids at the opposite poles

D Before metaphase, with condensed chromosomes and no functioning spindle

> **Answer 316: D**
>
> Correct. Mitosis is arrested at the stage before metaphase.

Genetics 4-6, slide 68 · Mitosis · Devil

317. At anaphase of mitosis in a human cell, how many separated chromosomes are present in the whole cell?

A 92

B 46

C 23

D 184

> **Answer 317: A**
>
> Correct. 46 chromosomes had two chromatids; once separated, 92 chromosomes are counted.

Genetics 4-6, slide 70 · Mitosis · Devil

318. A pea cell has 14 chromosomes. How many chromosomes does each daughter nucleus receive after mitosis?

A 7
B 14
C 28
D 21

> **Answer 318: B**
> Correct. Mitosis gives each daughter cell the full chromosome number.

Genetics 4-6, slide 63 · Mitosis · Devil

319. A drug stops spindle assembly in cells that are in prophase. What is the immediate result?

A Chromosomes separate early, before they have lined up at the equator
B The cell skips cytokinesis and moves directly into S phase
C The nucleolus reappears and the nuclear membrane reforms
D Chromosomes cannot align at the equator, so mitosis stalls

> **Answer 319: D**
> Correct. Without a spindle, alignment cannot occur.

slides 64-70 · Mitosis · Devil

320. Match each stage of mitosis with its key event.
(i) Prophase
(ii) Metaphase
(iii) Anaphase

A (i) Sister chromatids align; (ii) chromosomes condense; (iii) nuclei reform
B (i) Chromosomes condense; (ii) sister chromatids align at the equator; (iii) sister chromatids separate
C (i) Sister chromatids separate; (ii) chromosomes condense; (iii) chromosomes align
D (i) Nuclei reform; (ii) sister chromatids separate; (iii) chromosomes condense

> **Answer 320: B**
> Correct. Prophase condenses chromosomes, metaphase aligns them, and anaphase separates the chromatids.

Genetics 4-6, slide 67 · Mitosis · Devil

321. A student sees V-shaped chromosomes moving to opposite poles. Which stage and chromosome type does this indicate?

A Metaphase, with telocentric chromosomes
B Anaphase, with telocentric chromosomes
C Anaphase, with metacentric chromosomes
D Telophase, with submetacentric chromosomes

> **Answer 321: C**
> Correct. Metacentric chromosomes appear V-shaped as they move in anaphase.

4. Meiosis I

Genetics 4-6, slide 75 · Meiosis I · Easy

322. How many cells does one diploid cell produce by meiosis, and with what chromosome number?

A Two cells, each diploid
B Four cells, each haploid
C Two cells, each haploid
D Four cells, each diploid

> **Answer 322: B**
> Correct. Meiosis gives four haploid cells.

Genetics 4-6, slide 75 · Meiosis I · Easy

323. How many DNA replications occur in meiosis?

A Two
B Three
C None
D One

> **Answer 323: D**
> Correct. Meiosis involves a single DNA replication and two divisions.

Genetics 4-6, slide 77 · Meiosis I · Medium

324. What is synapsis?

A The side-by-side pairing of homologous chromosomes
B The separation of the sister chromatids at the start of anaphase II
C The exchange of cytoplasm between two adjacent cells
D The condensation of a single chromosome into a rod

> **Answer 324: A**
> Correct. Synapsis is the pairing of homologues.

Genetics 4-6, slide 77 · Meiosis I · Medium

325. What is a bivalent?

A A single chromosome made of one chromatid only
B A pair of sister chromatids that are still joined at one centromere
C A pair of synapsed homologous chromosomes, also called a tetrad
D A single chromosome that has two centromeres

Answer 325: C

Correct. Two chromosomes (four chromatids) make a bivalent or tetrad.

Genetics 4-6, slide 79 · Meiosis I · Medium

326. During which stage does crossing over occur?

A Metaphase I

B Anaphase II

C Telophase II

D Prophase I of meiosis

Answer 326: D

Correct. Crossing over takes place in prophase I.

Genetics 4-6, slide 99 · Meiosis I · Medium

327. What is the function of the synaptonemal complex?

A To make the spindle fibres that pull the chromosomes to the poles

B To copy DNA before the first meiotic division

C To let interacting chromatids complete their crossing over

D To divide the cytoplasm after the nuclear division

Answer 327: C

Correct. It supports crossing over.

Genetics 4-6, slide 100 · Meiosis I · Medium

328. What is a chiasma?

A The point where homologous non-sister chromatids exchange segments

B The point where spindle fibres attach to the centromere of each chromosome

C The pinch that divides the cytoplasm of animal cells

D The gap that separates two neighbouring daughter cells

Answer 328: A

Correct. Chiasmata mark crossing over.

Genetics 4-6, slide 81 · Meiosis I · Hard

329. Which is the correct order of the five stages of prophase I?

A Zygonema, leptonema, pachynema, diplonema, diakinesis

B Leptonema, zygonema, pachynema, diplonema, diakinesis

C Leptonema, pachynema, zygonema, diplonema, diakinesis

D Diakinesis, diplonema, pachynema, zygonema, leptonema

Answer 329: B

Correct. The order is thin thread, joined thread, thick thread, double thread, then diakinesis.

Genetics 4-6, slide 84 · Meiosis I · Hard

330. What separates in anaphase I of meiosis?

A Sister chromatids of each chromosome at the centromere

B Centrioles at the two poles of the cell

C Homologous chromosomes, each still two chromatids

D Nucleoli inside the nucleus of the cell

> **Answer 330: C**
>
> Correct. Homologues move to opposite poles with centromeres intact.

Genetics 4-6, slide 85 · Meiosis I · Hard

331. What is an important difference between mitotic anaphase and meiotic anaphase I?

A In anaphase I the nucleus divides first

B In mitosis the centromeres never divide

C Anaphase I has no spindle fibres

D In anaphase I the centromeres do not divide

> **Answer 331: D**
>
> Correct. The centromeres stay intact in anaphase I.

Genetics 4-6, slide 86 · Meiosis I · Hard

332. What does telophase I produce?

A Four haploid cells

B Two haploid daughter cells

C Two diploid cells

D One tetraploid cell

> **Answer 332: B**
>
> Correct. Cytokinesis divides the cell into two haploid daughter cells.

Genetics 4-6, slide 83 · Meiosis I · Hard

333. What makes metaphase I different from mitotic metaphase?

A Homologous pairs line up as bivalents, not as single chromosomes

B Chromosomes have not yet replicated their DNA before metaphase I begins

C Chromosomes line up in single file as separate individuals

D There is no spindle to move the chromosomes in metaphase I

> **Answer 333: A**
>
> Correct. Pairing makes metaphase I distinct.

Genetics 4-6, slide 95 · Meiosis I · Hard

334. Between which chromatids does crossing over occur?

A Sister chromatids of one chromosome

B Non-sister chromatids of homologous chromosomes

C Chromatids of non-homologous chromosomes only

D Chromatids of different species

> **Answer 334: B**
> Correct. Exchange is between non-sister chromatids.

Genetics 4-6, slide 75 · Meiosis I · Hard

335. Why is meiosis I called a reductional division?

A It reduces the chromosome number from diploid to haploid

B It reduces the number of cell divisions in meiosis to just one

C It reduces DNA replication to zero before the first division

D It reduces the whole cell cycle to a single mitosis

> **Answer 335: A**
> Correct. Meiosis I halves the chromosome number.

Genetics 4-6, slide 83 · Meiosis I · Hard

336. In which stage of meiosis I do the bivalents orient at random on the equatorial plane?

A Prophase I

B Anaphase I

C Telophase I

D Metaphase I

> **Answer 336: D**
> Correct. Bivalents orient at random at metaphase I.

Genetics 4-6, slide 77 · Meiosis I · Devil

337. How many bivalents form at metaphase I in a human cell?

A 46

B 92

C 23

D 11

> **Answer 337: C**
> Correct. 46 chromosomes pair into 23 bivalents.

Genetics 4-6, slide 77 · Meiosis I · Devil

338. How many chromatids does one tetrad contain?

A Two

B Eight

C One

D Four

> **Answer 338: D**
>
> Correct. A tetrad is two homologues, each with two sister chromatids.

Genetics 4-6, slide 77 · Meiosis I · Devil

339. A pea cell (2n = 14) enters meiosis. How many bivalents appear at metaphase I?

A 14

B 7

C 28

D 3

> **Answer 339: B**
>
> Correct. 14 chromosomes form 7 bivalents.

Genetics 4-6, slide 87 · Meiosis I · Devil

340. If homologues fail to disjoin at anaphase I, what do the resulting gametes contain?

A A normal single copy of each chromosome in every one of the gametes made

B Double the normal number of every chromosome in all gametes

C Two copies of those chromosomes in some gametes and none in others

D No chromosomes at all in any of the gametes made

> **Answer 340: C**
>
> Correct. Nondisjunction gives gametes with two of those chromosomes, or none.

Genetics 4-6, slide 84 · Meiosis I · Devil

341. Why do sister chromatids stay together in anaphase I?

A The centromeres do not divide, so each homologue moves whole

B Each chromatid has already separated from its sister chromatid at the centromere

C The spindle fibres are broken before anaphase begins

D The nucleus has not yet formed around the chromosomes

> **Answer 341: A**
>
> Correct. Undivided centromeres hold the chromatids together.

5. Meiosis II and comparison with mitosis

Genetics 4-6, slide 88 · Meiosis II and comparison with mitosis · Easy

342. What is the period between the first and second meiotic divisions called?

A Interphase

B Cytokinesis

C Interkinesis

D Synapsis

> **Answer 342: C**
>
> Correct. The lecture names the gap interkinesis.

Genetics 4-6, slide 88 · Meiosis II and comparison with mitosis · Medium

343. Does new DNA synthesis occur during interkinesis?

A No, there is no synthesis of new DNA

B Yes, all the DNA is replicated again

C Yes, but only the sex chromosomes replicate

D Yes, but only mitochondrial DNA replicates

> **Answer 343: A**
>
> Correct. Interkinesis differs from interphase because there is no DNA synthesis.

Genetics 4-6, slide 76 · Meiosis II and comparison with mitosis · Medium

344. Which meiotic division is described as equational?

A Meiosis I

B Meiosis II

C Prophase I

D Interkinesis

> **Answer 344: B**
>
> Correct. Meiosis II separates sister chromatids like mitosis.

Genetics 4-6, slide 91 · Meiosis II and comparison with mitosis · Medium

345. What happens in anaphase II?

A Homologues move to opposite poles while their centromeres stay undivided

B Chromosomes pair as bivalents on the spindle equator

C Crossing over takes place between non-sister chromatids

D Each centromere divides and sister chromatids move to opposite poles

> **Answer 345: D**
>
> Correct. Anaphase II separates sister chromatids.

Genetics 4-6, slide 92 · Meiosis II and comparison with mitosis · Medium

346. What are the end products of meiosis II in a diploid mother cell?

A Four haploid progeny cells

B Two diploid cells

C Four diploid cells

D Two haploid cells

> **Answer 346: A**
>
> Correct. A diploid mother cell becomes four haploid cells.

Genetics 4-6, slide 91 · Meiosis II and comparison with mitosis · Hard

347. In which meiotic stage do the centromeres divide?

A Anaphase I

B Anaphase II

C Prophase I

D Metaphase I

> **Answer 347: B**
>
> Correct. Centromeres divide in anaphase II.

Genetics 4-6, slide 93 · Meiosis II and comparison with mitosis · Hard

348. Which event distinguishes prophase I of meiosis from mitotic prophase?

A The nuclear envelope breaks down and the spindle begins to form

B The chromosomes condense and become visible as rods

C The cell has already replicated all of its DNA

D Homologues synapse into tetrads and crossing over occurs

> **Answer 348: D**
>
> Correct. Synapsis and crossing over are unique to prophase I.

Genetics 4-6, slide 93 · Meiosis II and comparison with mitosis · Hard

349. How many cells are produced by mitosis and by meiosis from one diploid parent cell?

A Four and two

B Two and two

C Two and four

D Four and four

> **Answer 349: C**
>
> Correct. Mitosis gives two cells and meiosis gives four.

Genetics 4-6, slide 90 · Meiosis II and comparison with mitosis · Hard

350. At metaphase II, how are the chromosomes arranged?

A Paired as bivalents and attached to the spindle by their centromeres

B Scattered through the cell with no alignment of any kind

C Already moved to the opposite poles of the cell before metaphase

D Attached to spindle fibres at their centromeres on the equatorial plane

> **Answer 350: D**
>
> Correct. Metaphase II chromosomes align on the plate.

Genetics 4-6, slide 76 · Meiosis II and comparison with mitosis · Hard

351. Why is meiosis II described as an equational division?

A It halves the chromosome number, as meiosis I does, from diploid to haploid

B It is like a mitotic division, separating sister chromatids

C It pairs homologous chromosomes at the metaphase plate

D It replicates the DNA just before the division begins

> **Answer 351: B**
>
> Correct. Meiosis II separates sister chromatids as in mitosis.

Genetics 4-6, slide 89 · Meiosis II and comparison with mitosis · Hard

352. Which stage of meiosis II is described as very brief, with chromosomes recondensing and spindle fibres reforming?

A Prophase II

B Metaphase II

C Anaphase II

D Telophase II

> **Answer 352: A**
>
> Correct. Prophase II is brief.

Genetics 4-6, slide 92 · Meiosis II and comparison with mitosis · Devil

353. A cell with 2n = 8 undergoes meiosis. How many chromosomes does each cell have after meiosis II?

A 8

B 2

C 4

D 16

> **Answer 353: C**
>
> Correct. Each of the four haploid cells has n = 4 chromosomes.

Genetics 4-6, slide 90 · Meiosis II and comparison with mitosis · Devil

354. A cell with 2n = 20 reaches metaphase II. How many chromosomes and chromatids does each cell carry?

A 20 chromosomes and 20 chromatids

B 10 chromosomes and 20 chromatids

C 10 chromosomes and 10 chromatids

D 20 chromosomes and 40 chromatids

> **Answer 354: B**
>
> Correct. After meiosis I each cell has 10 chromosomes, each with two chromatids.

Genetics 4-6, slide 91 · Meiosis II and comparison with mitosis · Devil

355. Counting separated chromatids as chromosomes, how many chromosomes does one human cell have in anaphase II?

A 23

B 92

C 11

D 46

> **Answer 355: D**
>
> Correct. A secondary cell has 23 chromosomes of two chromatids each, giving 46 once separated.

slides 75-93 · Meiosis II and comparison with mitosis · Devil

356. Match each division with its description.
(i) Meiosis I
(ii) Meiosis II
(iii) Mitosis

A (i) Equational; (ii) reductional; (iii) non-reductional

B (i) Reductional; (ii) equational; (iii) non-reductional

C (i) Reductional; (ii) non-reductional; (iii) equational

D (i) Non-reductional; (ii) reductional; (iii) equational

> **Answer 356: B**
>
> Correct. Meiosis I reduces the chromosome number, meiosis II separates sister chromatids, and mitosis keeps the number.

Genetics 4-6, slide 75 · Meiosis II and comparison with mitosis · Devil

357. Across the whole of meiosis, when does DNA replication occur?

A Once, before meiosis I, and not before meiosis II

B Before both the first and the second meiotic divisions

C Only before meiosis II and not before meiosis I

D In prophase I, together with crossing over

Answer 357: A

Correct. A single replication supports two divisions.

6. Genetic variation and the significance of meiosis

Genetics 4-6, slide 79 · Genetic variation and the significance of meiosis · Easy

358. Which two events in meiosis create genetic variation?

A DNA replication in S phase and cytokinesis at the end

B Spindle formation in prophase and nuclear division in telophase II

C Crossing over in prophase I, independent assortment in metaphase I

D Chromosome condensation in prophase and cell growth in G1

Answer 358: C

Correct. These are the two events named for variation.

Genetics 4-6, slide 94 · Genetic variation and the significance of meiosis · Medium

359. What does meiosis conserve from generation to generation?

A The total number of cells in every organism across the generations

B The size and the shape of each gamete produced by a parent

C The number of chromosomes in sexually reproducing organisms

D The sex of every offspring produced in the next generation

Answer 359: C

Correct. Meiosis keeps the chromosome number constant across generations.

Genetics 4-6, slide 95 · Genetic variation and the significance of meiosis · Medium

360. What does crossing over contribute to gametes?

A A doubling of the chromosome number in each of the gametes produced

B The loss of the sex chromosomes from every gamete

C A copy of every stage of the mitotic cell cycle

D Recombination of paternal and maternal hereditary traits

Answer 360: D

Correct. Crossing over recombines maternal and paternal alleles.

Genetics 4-6, slide 74 · Genetic variation and the significance of meiosis · Medium

361. What is syngamy?

A The pairing of homologous chromosomes at the start of meiosis I

B The union of a male and a female gamete, or fertilization

C The division of the centromere in anaphase II

D The condensation of chromatin into chromosomes

Answer 361: B

Correct. Syngamy is fertilization to form a zygote.

Genetics 4-6, slide 95 · Genetic variation and the significance of meiosis · Hard

362. Why is the number of different kinds of gametes said to be virtually infinite?

A Crossing over between non-sister chromatids reshuffles the genes

B Gametes are replicated indefinitely after they form

C Mutations occur in every single gamete that is made

D Each gamete belongs to a completely different species of organism

> **Answer 362: A**
>
> Correct. Exchange between chromatids multiplies the possible gametes.

Genetics 4-6, slide 94 · Genetic variation and the significance of meiosis · Hard

363. What would happen to the chromosome number across generations if fertilization occurred without meiosis?

A It would halve each generation

B It would double each generation

C It would stay the same

D It would vary at random with no limit

> **Answer 363: B**
>
> Correct. Fusing two diploid gametes would double the number every generation.

Genetics 4-6, slide 79 · Genetic variation and the significance of meiosis · Hard

364. In which stage of meiosis does independent assortment occur?

A Metaphase I

B Prophase II

C Telophase II

D Interkinesis

> **Answer 364: A**
>
> Correct. Bivalents orient at random at metaphase I.

Genetics 4-6, slide 95 · Genetic variation and the significance of meiosis · Hard

365. How does crossing over differ in effect from independent assortment?

A Crossing over shuffles whole chromosomes; independent assortment swaps segments between homologues

B They are one and the same process, occurring at two different stages

C Neither process changes the genetic make-up of the gametes

D Crossing over swaps segments between homologues; assortment shuffles whole chromosomes

> **Answer 365: D**
>
> Correct. One reshuffles within chromosomes, the other between whole chromosomes.

Genetics 4-6, slide 94 · Genetic variation and the significance of meiosis · Hard

366. What does fertilization restore in the zygote?

A The haploid chromosome number

B A tetraploid number

C The diploid chromosome number

D No chromosomes

> **Answer 366: C**
>
> Correct. Two haploid gametes fuse to make a diploid zygote.

Genetics 4-6, slide 95 · Genetic variation and the significance of meiosis · Hard

367. What do the gametes from one individual show about genetic variation?

A They differ because of crossing over and independent assortment

B They are all genetically identical to one another and to the parent cell

C They carry only maternal chromosomes and no paternal ones

D They carry only paternal chromosomes and no maternal ones

> **Answer 367: A**
>
> Correct. Meiosis makes genetically different gametes.

Genetics 4-6, slide 79; general · Genetic variation and the significance of meiosis · Devil

368. A pea plant has 2n = 14. Considering independent assortment alone, how many different gamete combinations can it make?

A 14

B 128

C 49

D 7

> **Answer 368: B**
>
> Correct. Each of the 7 bivalents orients in two ways, giving $2^7 = 128$.

Genetics 4-6, slide 94 · Genetic variation and the significance of meiosis · Devil

369. Why does sexual reproduction require meiosis?

A Meiosis makes the gametes genetically identical to each other and to the parent

B Mitosis is the division that makes haploid gametes in animals

C Fertilization halves the chromosome number of the zygote

D Fertilization joins two gametes, so meiosis must halve the number first

> **Answer 369: D**
>
> Correct. Halving before fertilization keeps the number constant.

Genetics 4-6, slide 95 · Genetic variation and the significance of meiosis · Devil

370. A student says crossing over happens between sister chromatids and gives variation. What is wrong?

A Crossing over occurs only between sister chromatids of one chromosome

B Sister chromatids carry different alleles of every gene they contain

C Crossing over is between non-sister chromatids, since sisters are identical

D Crossing over occurs only in mitosis and never in meiosis

> **Answer 370: C**
>
> Correct. Exchange must be between non-sister chromatids to recombine alleles.

Genetics 4-6, slide 79; general · Genetic variation and the significance of meiosis · Devil

371. Considering independent assortment alone, about how many different gametes can a human produce?

A About 8.4 million (2^{23})

B About 46

C About 529 (23^2)

D About 23

> **Answer 371: A**
>
> Correct. 23 bivalents each orient in two ways, giving $2^{23} \approx 8.4$ million.

Module 6: Variation in chromosome number and structure — 118 questions

1. Euploidy and polyploidy

Genetics 4-6, slide 106 · Euploidy and polyploidy · Easy

372. What condition is described as euploidy?

A The gain or loss of a single whole chromosome from the set

B The loss of a part of one chromosome of a pair

C The breakage of a chromosome arm near the centromere

D One or more complete haploid sets of chromosomes

> **Answer 372: D**
> Correct. Euploidy involves complete sets of chromosomes.

Genetics 4-6, slide 108 · Euploidy and polyploidy · Easy

373. How many sets of chromosomes does a triploid have?

A Two

B Three

C Four

D One

> **Answer 373: B**
> Correct. Triploid means three sets (3n).

Genetics 4-6, slide 104 · Euploidy and polyploidy · Easy

374. About what fraction of flowering plants (angiosperms) are polyploid?

A About one tenth

B About one half

C About one third

D Almost none

> **Answer 374: C**
> Correct. The lecture estimates one third.

Genetics 4-6, slide 107 · Euploidy and polyploidy · Medium

375. What is a monoploid?

A An organism that is missing one chromosome of a pair

B An organism with three complete sets of chromosomes

C An organism with a single extra chromosome in its set

D An organism with only one set of chromosomes (n)

> **Answer 375: D**
> Correct. Monoploids have one set, as in nuclei of some fungi.

Genetics 4-6, slide 107 · Euploidy and polyploidy · Medium

376. How are monoploids in higher organisms usually described?

A Larger and more vigorous than normal diploids; plants are usually fertile

B Always fertile and more vigorous in both plants and animals

C Smaller and less vigorous than diploids; plants are usually sterile

D Common in most animal populations and often seen in humans

> **Answer 376: C**
>
> Correct. Monoploid animals rarely survive and monoploid plants are usually sterile.

Genetics 4-6, slide 108 · Euploidy and polyploidy · Medium

377. How can a triploid arise?

A From the union of a monoploid gamete (n) with a diploid gamete (2n)

B From the union of two monoploid gametes (n + n) in a normal fertilization

C From the loss of one chromosome during division

D From the breakage of one chromosome during division

> **Answer 377: A**
>
> Correct. n + 2n gives 3n.

Genetics 4-6, slide 108 · Euploidy and polyploidy · Medium

378. Why are triploids sterile and rare in natural populations?

A They have no chromosomes at all in any of their body cells or gametes

B The extra set divides unevenly, making unbalanced gametes

C They cannot undergo mitosis in their somatic cells

D They have only one sex and cannot find a mate

> **Answer 378: B**
>
> Correct. Unbalanced gametes make triploids sterile.

Genetics 4-6, slide 109 · Euploidy and polyploidy · Medium

379. How can tetraploids (4n) arise in body cells?

A By losing a whole chromosome pair during cell division

B By one sperm fertilizing two eggs at the same time

C By deletion of a segment from one chromosome arm in the cell

D By somatic doubling, spontaneously or induced by colchicine

> **Answer 379: D**
>
> Correct. Doubling can be spontaneous or chemical.

Genetics 4-6, slide 109 · Euploidy and polyploidy · Medium

380. What substance is used to induce chromosome doubling at high frequency?

A Penicillin

B Insulin

C Colchicine

D Glucose

> **Answer 380: C**
>
> Correct. The lecture names colchicine as the inducer.

Genetics 4-6, slide 108 · Euploidy and polyploidy · Hard

381. The garden pea has 2n = 14. How many chromosomes does a triploid pea have?

A 14

B 21

C 28

D 7

> **Answer 381: B**
>
> Correct. Three sets of 7 gives 21.

Genetics 4-6, slide 109 · Euploidy and polyploidy · Hard

382. The garden pea has 2n = 14. How many chromosomes does a tetraploid pea have?

A 28

B 21

C 14

D 7

> **Answer 382: A**
>
> Correct. Four sets of 7 gives 28.

Genetics 4-6, slide 108 · Euploidy and polyploidy · Hard

383. A species has 2n = 24. How many chromosomes does a triploid cell contain?

A 24

B 48

C 12

D 36

> **Answer 383: D**
>
> Correct. n = 12, so 3n = 36.

Genetics 4-6, slide 109 · Euploidy and polyploidy · Hard

384. Cattle have 2n = 60. How many chromosomes would a tetraploid cattle cell contain?

A 90
B 60
C 120
D 30

> **Answer 384: C**
> Correct. n = 30, so 4n = 120.

Genetics 4-6, slide 108 · Euploidy and polyploidy · Hard

385. How many chromosomes would a triploid human cell contain?

A 46
B 69
C 92
D 23

> **Answer 385: B**
> Correct. n = 23, so 3n = 69.

Genetics 4-6, slide 109 · Euploidy and polyploidy · Hard

386. How many chromosomes would a tetraploid human cell contain?

A 92
B 69
C 46
D 184

> **Answer 386: A**
> Correct. n = 23, so 4n = 92.

Genetics 4-6, slide 109 · Euploidy and polyploidy · Hard

387. Besides somatic doubling, how else can tetraploids arise?

A By the union of two normal monoploid (n) gametes
B By the loss of a single chromosome in meiosis
C By crossing over between two non-sister chromatids
D By the union of unreduced diploid (2n) gametes

> **Answer 387: D**
> Correct. Two 2n gametes give 4n.

Genetics 4-6, slide 105 · Euploidy and polyploidy · Hard

388. What range does variation in chromosome number cover?

A Only the loss of a single chromosome from the diploid set of cells

B From gain or loss of one chromosome to whole haploid sets

C Only the doubling of a single chromosome within the set

D Only the addition of whole sets of chromosomes to a cell

> **Answer 388: B**
>
> Correct. Variation includes both single chromosomes and whole sets.

Genetics 4-6, slide 108 · Euploidy and polyploidy · Devil

389. A pea plant (n = 7) forms a triploid from a monoploid gamete and a diploid gamete. How many chromosomes come from each gamete?

A 14 from each of the two gametes, giving a total of 28 chromosomes

B 7 from each of the two gametes, giving 14 in total

C 7 from the monoploid gamete and 14 from the diploid gamete

D 21 from the diploid gamete and none from the monoploid

> **Answer 389: C**
>
> Correct. n + 2n = 7 + 14 = 21.

Genetics 4-6, slide 106 · Euploidy and polyploidy · Devil

390. A plant of a species with 2n = 20 has cells with 30 chromosomes. Which description fits?

A Triploid, an example of euploidy

B Trisomic, an example of aneuploidy

C Tetraploid, an example of euploidy

D Monosomic, an example of aneuploidy

> **Answer 390: A**
>
> Correct. 30 is three sets of 10, which is euploid.

Genetics 4-6, slide 106 · Euploidy and polyploidy · Devil

391. A plant species with 2n = 40 has an individual with 41 chromosomes. Which term fits?

A Triploid (3n)

B Aneuploid (trisomic, 2n + 1)

C Euploid (4n)

D Monoploid (n)

> **Answer 391: B**
>
> Correct. One extra chromosome gives 2n + 1.

Genetics 4-6, slide 107 · Euploidy and polyploidy · Devil

392. Why are few monoploid animals able to survive?

A They have too many sets of chromosomes, which makes them unstable

B They cannot undergo any form of cell division at all

C They contain only sex chromosomes and no autosomes

D Having one set unmasks recessive alleles, reducing viability

> **Answer 392: D**
>
> Correct. The lecture says monoploids are usually less viable.

Genetics 4-6, slide 108 · Euploidy and polyploidy · Devil

393. Which statement distinguishes euploidy from aneuploidy?

A Euploidy changes whole sets; aneuploidy changes parts of a set

B Euploidy changes single chromosomes, while aneuploidy changes whole sets of them

C Both change only single chromosomes, never whole sets

D Neither of them changes the chromosome number at all

> **Answer 393: A**
>
> Correct. Euploidy involves whole sets and aneuploidy involves single chromosomes.

2. Aneuploidy and nondisjunction

Genetics 4-6, slide 111 · Aneuploidy and nondisjunction · Easy

394. Which suffix is part of the nomenclature of aneuploid conditions?

A -ploid

B -genic

C -somic

D -static

> **Answer 394: C**
>
> Correct. Names such as monosomic and trisomic use -somic.

Genetics 4-6, slide 116 · Aneuploidy and nondisjunction · Easy

395. What is the chromosomal formula of a monosomic?

A 2n + 1

B 2n – 2

C 3n

D 2n – 1

> **Answer 395: D**
>
> Correct. A monosomic lacks one chromosome of a pair.

Genetics 4-6, slide 119 · Aneuploidy and nondisjunction · Medium

396. What is the chromosomal formula of a trisomic?

A 2n – 1

B 2n + 1

C 2n – 2

D 4n

> **Answer 396: B**
>
> Correct. A trisomic has one extra chromosome.

Genetics 4-6, slide 121 · Aneuploidy and nondisjunction · Medium

397. What is a nullisomic?

A An organism that has lost a chromosome pair (2n – 2)

B An organism with a single extra chromosome (2n + 1)

C An organism with a missing sex chromosome only

D An organism with four complete sets of chromosomes (4n)

> **Answer 397: A**
>
> Correct. A nullisomic lacks both members of a pair.

Genetics 4-6, slide 118 · Aneuploidy and nondisjunction · Medium

398. Which two kinds of gametes can a monosomic form?

A n and n + 1

B 2n and n

C n and n – 1

D n – 1 and n – 2

> **Answer 398: C**
>
> Correct. Monosomics make n and n – 1 gametes.

Genetics 4-6, slide 119 · Aneuploidy and nondisjunction · Medium

399. Which two kinds of gametes can a trisomic form?

A n and n – 1

B n + 1 and n

C 2n and n

D n – 1 and n + 2

> **Answer 399: B**
>
> Correct. Trisomics make n + 1 and n gametes.

Genetics 4-6, slide 112 · Aneuploidy and nondisjunction · Medium

400. Aneuploidy can arise through which two events?

A Unequal crossing over between chromatids only

B Spindle formation in normal dividing cells only

C Primary or secondary nondisjunction

D DNA replication during S phase of interphase only

> **Answer 400: C**
>
> Correct. Nondisjunction produces gametes with too many or too few chromosomes.

Genetics 4-6, slide 116 · Aneuploidy and nondisjunction · Hard

401. A species has 2n = 46. How many chromosomes does a monosomic cell contain?

A 47

B 44

C 46

D 45

> **Answer 401: D**
>
> Correct. 2n − 1 = 45.

Genetics 4-6, slide 119 · Aneuploidy and nondisjunction · Hard

402. A species has 2n = 14. How many chromosomes does a trisomic cell contain?

A 15

B 13

C 16

D 12

> **Answer 402: A**
>
> Correct. 2n + 1 = 15.

Genetics 4-6, slide 121 · Aneuploidy and nondisjunction · Hard

403. A species has 2n = 14. How many chromosomes does a nullisomic cell contain?

A 12

B 13

C 15

D 7

> **Answer 403: A**
>
> Correct. 2n − 2 = 12.

Genetics 4-6, slide 118 · Aneuploidy and nondisjunction · Hard

404. A species has n = 10. What chromosome numbers can the gametes of a monosomic have?

A 10 and 11

B 10 and 9

C 20 and 19

D 9 and 8

> **Answer 404: B**
>
> Correct. n = 10 and n – 1 = 9.

Genetics 4-6, slide 119 · Aneuploidy and nondisjunction · Hard

405. A species has n = 10. What chromosome numbers can the gametes of a trisomic have?

A 10 and 9

B 22 and 21

C 11 and 10

D 12 and 11

> **Answer 405: C**
>
> Correct. n + 1 = 11 and n = 10.

Genetics 4-6, slide 114 · Aneuploidy and nondisjunction · Hard

406. What is anaphase lag?

A Failure of the DNA in the chromosomes to replicate during interphase

B The loss of the whole spindle apparatus before anaphase

C The doubling of every chromosome in the dividing cell

D Delayed chromosome movement, so it is left out of a daughter nucleus

> **Answer 406: D**
>
> Correct. A lagging chromosome may be lost or captured in one cell.

Genetics 4-6, slide 114 · Aneuploidy and nondisjunction · Hard

407. In humans, how does aneuploidy arise at anaphase?

A The nuclear envelope fails to form around the chromosomes

B The cell makes extra centrioles that disturb the spindle

C The cell cycle skips interphase and goes straight to mitosis

D Paired chromosomes or sister chromatids fail to disjoin

> **Answer 407: D**
>
> Correct. Failure to disjoin (nondisjunction) is the cause.

Genetics 4-6, slide 118 · Aneuploidy and nondisjunction · Hard

408. What is the usual effect in animals of losing one whole chromosome?

A Larger size and extra vigour from the added genetic material in cells

B No effect at all on the development of the animal

C High mortality or reduced fertility from genetic imbalance

D Immediate sex change in the developing embryo

> **Answer 408: C**
>
> Correct. Genetic imbalance is usually harmful.

Genetics 4-6, slide 114 · Aneuploidy and nondisjunction · Hard

409. A cell of a species with 2n = 20 loses one chromosome by anaphase lag. How many chromosomes does the affected daughter cell have, and what is the condition?

A 19 chromosomes, monosomic

B 21 chromosomes, trisomic

C 18 chromosomes, nullisomic

D 20 chromosomes, normal

> **Answer 409: A**
>
> Correct. 2n − 1 = 19, which is monosomy.

Genetics 4-6, slide 113 · Aneuploidy and nondisjunction · Devil

410. If homologues fail to separate at meiosis I, what gametes do the four products carry?

A Four normal gametes, each with n chromosomes

B Two gametes with n + 1 and two gametes with n − 1

C Two normal gametes, one n + 1 and one n − 1 chromosomes

D Four gametes, all of which carry n + 1 chromosomes

> **Answer 410: B**
>
> Correct. A meiosis I failure affects all four products.

Genetics 4-6, slide 113 · Aneuploidy and nondisjunction · Devil

411. If sister chromatids fail to separate at meiosis II in one cell, what gametes result from that cell line?

A Four gametes, all of which carry n + 1 chromosomes

B Four normal gametes, each with n chromosomes

C Two normal gametes, one n + 1 and one n − 1

D Two gametes with n + 1 and two gametes with n − 1

> **Answer 411: C**
>
> Correct. Only the affected secondary cell produces abnormal gametes.

Genetics 4-6, slide 113 · Aneuploidy and nondisjunction · Devil

412. A gamete with n − 1 fertilizes a normal gamete. What condition results?

A Monosomy (2n − 1)

B Trisomy (2n + 1)

C Nullisomy (2n − 2)

D Triploidy (3n)

> **Answer 412: A**
>
> Correct. n − 1 + n = 2n − 1.

Genetics 4-6, slide 113 · Aneuploidy and nondisjunction · Devil

413. A gamete with n + 1 fertilizes a normal gamete. What condition results?

A Monosomy (2n − 1)

B Nullisomy (2n − 2)

C Tetraploidy (4n)

D Trisomy (2n + 1)

> **Answer 413: D**
>
> Correct. n + 1 + n = 2n + 1.

Genetics 4-6, slide 122 · Aneuploidy and nondisjunction · Devil

414. Why can some polyploids, such as hexaploid wheat, survive the loss of two homologues of a set?

A They have no genes at all on those chromosomes that are missing

B Genetic redundancy: other sets carry copies of the lost genes

C They have no chromosomes at all in their somatic cells

D They repair the loss of a pair by mitosis within the cell

> **Answer 414: B**
>
> Correct. Extra sets provide backup copies.

Genetics 4-6, slide 121 · Aneuploidy and nondisjunction · Devil

415. Why is nullisomy usually lethal in diploids?

A The cell has too many chromosomes to divide normally and survive

B The extra pair of chromosomes blocks every mitosis

C The sex of the cell is lost when the pair disappears

D Both copies of the pair's genes are absent, with no backup

> **Answer 415: D**
>
> Correct. A diploid has no redundant copies of the lost pair.

3. Structural chromosome aberrations

Genetics 4-6, slide 132 · Structural chromosome aberrations · Easy

416. What is a deletion (deficiency)?

A The addition of an extra chromosome

B The reversal of a segment

C The loss of a chromosomal segment

D The exchange of segments between two chromosomes

> **Answer 416: C**
>
> Correct. A deletion is the loss of a segment.

Genetics 4-6, slide 140 · Structural chromosome aberrations · Easy

417. Which structural change is a 180° reversal of a chromosomal segment?

A Deletion

B Inversion

C Duplication

D Translocation

> **Answer 417: B**
>
> Correct. An inversion reverses a segment 180°.

Genetics 4-6, slide 135 · Structural chromosome aberrations · Medium

418. What is a duplication (repeat)?

A A segment present more than once in the same or another chromosome

B A segment that is missing from one arm of a chromosome

C A segment that is reversed in orientation by 180° in place

D A chromosome that has two functional centromeres and cannot divide

> **Answer 418: A**
>
> Correct. A duplication is a repeated segment.

Genetics 4-6, slide 134 · Structural chromosome aberrations · Medium

419. Cri-du-chat syndrome is associated with a heterozygous deficiency of which region?

A The long arm of chromosome 5

B The short arm of chromosome 21

C The short arm of chromosome 5

D The X chromosome

> **Answer 419: C**
>
> Correct. It is a deficiency in the short arm of chromosome 5.

Genetics 4-6, slide 143 · Structural chromosome aberrations · Medium

420. What is a reciprocal translocation?

A The loss of a segment from one chromosome arm and its genes

B The 180° reversal of a segment within a single chromosome arm

C The doubling of the whole chromosome set in every cell of the body

D An exchange of blocks of genes between nonhomologous chromosomes

> **Answer 420: D**
>
> Correct. Blocks are exchanged between nonhomologues.

Genetics 4-6, slide 146 · Structural chromosome aberrations · Medium

421. What is a centric fusion (Robertsonian change)?

A Two nonhomologous chromosomes joining at the centromere to make one

B One metacentric chromosome splitting into two telocentric chromosomes

C Two homologous chromosomes pairing side by side in prophase I

D A segment that is reversed within a single chromosome arm

> **Answer 421: A**
>
> Correct. Fusion joins two chromosomes into one metacentric.

Genetics 4-6, slide 147 · Structural chromosome aberrations · Medium

422. What is a centric fission?

A Two telocentric chromosomes joining together at the centromere to form one

B One metacentric chromosome splitting into two telocentric chromosomes

C The loss of a segment from the end of one chromosome arm

D The addition of one complete haploid set to the genome

> **Answer 422: B**
>
> Correct. Fission is the reciprocal of fusion.

Genetics 4-6, slide 141 · Structural chromosome aberrations · Medium

423. A chromosome has the gene order ABCDEFGH. After inversion of the segment DEF, what is the new order?

A ABCDEFGH

B HGFEDCBA

C ABCFEDGH

D ABCEDFGH

> **Answer 423: C**
>
> Correct. The segment DEF is reversed to FED.

Genetics 4-6, slide 141 · Structural chromosome aberrations · Medium

424. A chromosome has the gene order ABCDEFGH. What order remains after deletion of the segment DE?

A ABCEFGH

B ABCFGH

C ABCEDFGH

D ABCDEFGH

> **Answer 424: B**
>
> Correct. D and E are lost.

Genetics 4-6, slide 132 · Structural chromosome aberrations · Hard

425. Why are deletions usually lethal in the homozygous condition?

A Both homologues lack the genes in the missing segment

B Both homologues carry an extra copy of the same segment

C The segment is reversed in both of the homologues

D The centromere is lost in both of the homologues

> **Answer 425: A**
>
> Correct. No functional copy of the missing genes remains.

Genetics 4-6, slide 141 · Structural chromosome aberrations · Hard

426. What is the difference between pericentric and paracentric inversions?

A Paracentric inversions include the centromere, while pericentric ones do not

B Pericentric inversions change the gene number, whereas paracentric ones do not

C Paracentric inversions delete genes, whereas pericentric ones do not

D Pericentric inversions include the centromere; paracentric ones do not

> **Answer 426: D**
>
> Correct. Pericentric includes the centromere.

Genetics 4-6, slide 140 · Structural chromosome aberrations · Hard

427. How does an inversion affect the number of chromosomes and genes?

A It increases the number of genes on the inverted chromosome segment

B It decreases the number of chromosomes in the cell

C It changes neither chromosome number nor gene number

D It changes both of the numbers, genes and chromosomes

> **Answer 427: C**
>
> Correct. Only gene order changes.

Genetics 4-6, slide 131 · Structural chromosome aberrations · Hard

428. Which pair of structural changes alter the number of genes on a chromosome?

A Inversions and translocations

B Inversions and deletions

C Translocations and duplications

D Deletions and duplications

> **Answer 428: D**
>
> Correct. Deletions lose genes and duplications add them.

Genetics 4-6, slide 131 · Structural chromosome aberrations · Hard

429. Which pair of structural changes alter the location of genes?

A Inversions and translocations

B Deletions and duplications

C Deletions and inversions

D Duplications and translocations

> **Answer 429: A**
>
> Correct. They change where genes sit.

Genetics 4-6, slide 139 · Structural chromosome aberrations · Hard

430. Which agents can cause chromosome breakage leading to duplications and deletions?

A Only visible light and heat from the sun

B Radiation, chemicals and viruses

C Only changes in temperature of the cell

D Only a high concentration of oxygen in the cell

> **Answer 430: B**
>
> Correct. The lecture lists radiation, chemicals and viruses, and unequal crossing over.

Genetics 4-6, slide 137 · Structural chromosome aberrations · Hard

431. What is a terminal duplication?

A A duplicated segment located at the end of the chromosome

B A duplicated segment located right next to the centromere

C A deleted segment lost from the end of the chromosome

D A segment that is reversed in the middle of the chromosome

> **Answer 431: A**
>
> Correct. A terminal duplication is at the chromosome end.

Genetics 4-6, slide 141 · Structural chromosome aberrations · Hard

432. A chromosome has the gene order ABCDEFGH. After inversion of the segment CDE, what is the new order?

A ABDCEFGH
B AEDCBFGH
C ABEDCFGH
D HGFEDCBA

> **Answer 432: C**
> Correct. The inverted segment CDE is reversed to read EDC.

Genetics 4-6, slide 141 · Structural chromosome aberrations · Hard

433. A chromosome has the gene order ABCDEFGH. After inversion of the segment FG, what is the new order?

A ABCDEHGF
B ABCDGFEH
C ABCDEFGH
D ABCDEGFH

> **Answer 433: D**
> Correct. The inverted segment FG is reversed to read GF.

Genetics 4-6, slide 141 · Structural chromosome aberrations · Hard

434. A chromosome has the gene order ABCDEFGH. What order results from deletion of the segment BCD?

A ADEFGH
B AEFGH
C ABFGH
D ADCBEFGH

> **Answer 434: B**
> Correct. B, C and D are lost.

Genetics 4-6, slide 141 · Structural chromosome aberrations · Hard

435. A chromosome has the gene order ABCDEFGH. What order results from a tandem duplication of the segment BC?

A ABCCBDEFGH
B ABCBCDEFGH
C ADEFGH
D ABCDEFGH

> **Answer 435: B**
> Correct. BC appears twice, side by side in the same direction.

Genetics 4-6, slide 141 · Structural chromosome aberrations · Hard

436. A chromosome has the gene order ABCDEFGH. What order results from a tandem duplication of the segment FG?

A ABCDEFGGFH

B ABCDEFEFGH

C ABCDEFGFGH

D ABCDEFGH

> **Answer 436: C**
>
> Correct. FG is repeated directly after itself.

Genetics 4-6, slide 141 · Structural chromosome aberrations · Hard

437. A chromosome has the gene order ABCDEFGH. What order results from a terminal duplication of the segment GH?

A ABCDEFGHGH

B ABCDEFGFGH

C ABCDEFGHHG

D ABCDEFGH

> **Answer 437: A**
>
> Correct. GH is repeated at the end of the chromosome.

Genetics 4-6, slide 141 · Structural chromosome aberrations · Hard

438. A cell with 2n = 24 undergoes one centric fusion of two nonhomologous chromosomes. How many chromosomes does it now have?

A 24

B 25

C 12

D 23

> **Answer 438: D**
>
> Correct. Two chromosomes join into one, leaving 23.

Genetics 4-6, slide 138 · Structural chromosome aberrations · Devil

439. A recessive homozygote fails to show the recessive phenotype. Which structural change might explain this?

A A deletion of the dominant allele

B A duplication carrying a dominant allele

C An inversion with no change in genes

D A fission of the chromosome

> **Answer 439: B**
>
> Correct. The duplicated dominant allele masks the recessive.

Genetics 4-6, slide 131 · Structural chromosome aberrations · Devil

440. A chromosome change moves genes without changing the number of genes. Which two changes could this be?

A Deletion or duplication

B Deletion or inversion

C Inversion or translocation

D Duplication or fission

> **Answer 440: C**
>
> Correct. Both rearrange gene location only.

Genetics 4-6, slide 141 · Structural chromosome aberrations · Devil

441. A chromosome has the gene order ABCDEFGH. What order results from a reverse tandem duplication of the segment CD?

A ABCDDCEFGH

B ABCDCDEFGH

C ABEFGH

D ABDCEFGH

> **Answer 441: A**
>
> Correct. CD is followed by a reversed copy DC.

Genetics 4-6, slide 141 · Structural chromosome aberrations · Devil

442. Two nonhomologous chromosomes are ABCDEF and GHIJKL. After a reciprocal translocation that exchanges DEF with IJKL, what are the two new chromosomes?

A ABCDEF and GHIJKL (no change)

B ABCIJKL and GHIJKL

C ABCDEF and GHDEF

D ABCIJKL and GHDEF

> **Answer 442: D**
>
> Correct. Each chromosome receives the other's tail segment.

Genetics 4-6, slide 141 · Structural chromosome aberrations · Devil

443. Two nonhomologous chromosomes are ABCDEF and GHIJKL. After a reciprocal translocation that exchanges EF with L, what are the two new chromosomes?

A ABCDL and GHIJKEF

B ABCDEF and GHIJKL (no change)

C ABCDL and GHIJKL

D ABCDEF and GHIJKEF

> **Answer 443: A**
>
> Correct. EF and L swap places.

Genetics 4-6, slide 141 · Structural chromosome aberrations · Devil

444. The centromere of ABCDEFGH lies between C and D (ABC•DEFGH). Inversion of which segment is pericentric?

A BC (it excludes the centromere)

B CD (it includes the centromere)

C FG (it excludes the centromere)

D GH (it excludes the centromere)

> **Answer 444: B**
>
> Correct. A pericentric inversion includes the centromere.

Genetics 4-6, slide 141 · Structural chromosome aberrations · Devil

445. The centromere of ABCDEFGH lies between C and D (ABC•DEFGH). Inversion of which segment is paracentric?

A CD (it includes the centromere)

B BE (it includes the centromere)

C EF (it lies in one arm)

D AH (it includes the centromere)

> **Answer 445: C**
>
> Correct. Paracentric inversions do not include the centromere.

4. Autosomal syndromes (Down, Patau, Edwards, cri-du-chat)

Genetics 4-6, slide 149 · Autosomal syndromes (Down, Patau, Edwards, cri-du-chat) · Easy

446. What is the karyotype notation of Down syndrome?

A 47, +13

B 47, +18

C 45, X

D 47, +21

> **Answer 446: D**
>
> Correct. Down syndrome is trisomy 21.

Genetics 4-6, slide 150 · Autosomal syndromes (Down, Patau, Edwards, cri-du-chat) · Easy

447. Down syndrome is also known as:

A Trisomy 21

B Trisomy 13

C Trisomy 18

D Monosomy 21

> **Answer 447: A**
>
> Correct. Three copies of chromosome 21 cause it.

Genetics 4-6, slide 150 · Autosomal syndromes (Down, Patau, Edwards, cri-du-chat) · Medium

448. What is the overall incidence of Down syndrome among Europeans?

A About 1 in 70

B About 1 in 20,000

C About 1 in 700 live births

D About 1 in 10,000

> **Answer 448: C**
>
> Correct. The lecture gives 1 in 700.

Genetics 4-6, slide 149 · Autosomal syndromes (Down, Patau, Edwards, cri-du-chat) · Medium

449. Most cases of Down syndrome result from nondisjunction at which division?

A The second mitotic division

B The second meiotic division only

C Fertilization

D The first meiotic division

> **Answer 449: D**
>
> Correct. The lecture gives the first meiotic division.

Genetics 4-6, slide 153 · Autosomal syndromes (Down, Patau, Edwards, cri-du-chat) · Medium

450. Patau syndrome is due to trisomy of which chromosome?

A Chromosome 18

B Chromosome 13

C Chromosome 21

D Chromosome 5

> **Answer 450: B**
>
> Correct. 47, +13 is trisomy 13.

Genetics 4-6, slide 156 · Autosomal syndromes (Down, Patau, Edwards, cri-du-chat) · Medium

451. Edwards syndrome is due to trisomy of which chromosome?

A Chromosome 18

B Chromosome 13

C Chromosome 21

D Chromosome 5

> **Answer 451: A**
>
> Correct. 47, +18 is trisomy 18.

Genetics 4-6, slide 153 · Autosomal syndromes (Down, Patau, Edwards, cri-du-chat) · Medium

452. About how common is Patau syndrome among newborns?

A About 1 in 700

B About 1 in 10,000

C About 1 in 100

D About 1 in 20,000

> **Answer 452: D**
>
> Correct. The lecture gives 1 in 20,000.

Genetics 4-6, slide 154 · Autosomal syndromes (Down, Patau, Edwards, cri-du-chat) · Hard

453. What is the survival pattern of children with Patau syndrome?

A Most live on to adulthood and have an almost normal lifespan

B About 50% die within a month; about 10% survive a year

C All of the children survive to at least age five years

D Only 1% die in infancy and the rest live long

> **Answer 453: B**
>
> Correct. Survival is poor, with most dying in the first year.

Genetics 4-6, slide 157 · Autosomal syndromes (Down, Patau, Edwards, cri-du-chat) · Hard

454. What proportion of Edwards syndrome cases are spontaneously aborted?

A About 5%

B About 50%

C About 95%

D About 20%

> **Answer 454: C**
>
> Correct. The lecture says 95%.

Genetics 4-6, slide 157 · Autosomal syndromes (Down, Patau, Edwards, cri-du-chat) · Hard

455. What is the mortality of Edwards syndrome by two years of age?

A 10 to 20%

B About 50%

C 80 to 90%

D Under 5%

> **Answer 455: C**
>
> Correct. Mortality is 80 to 90%.

Genetics 4-6, slide 155 · Autosomal syndromes (Down, Patau, Edwards, cri-du-chat) · Hard

456. Which feature is listed among Patau syndrome symptoms?

A Webbed neck and shield chest

B Eyelid fold and flat face only

C Taller than average

D Cleft lip and polydactyly

> **Answer 456: D**
>
> Correct. Patau symptoms include cleft lip and polydactyly.

Genetics 4-6, slide 158 · Autosomal syndromes (Down, Patau, Edwards, cri-du-chat) · Hard

457. Which diagnostic feature is listed for Edwards syndrome?

A Malformed ears and a receding mandible

B Cleft lip and extra fingers (polydactyly)

C A high-pitched, cat-like cry in newborn infants

D A webbed neck and a shield-shaped chest

> **Answer 457: A**
>
> Correct. Malformed ears and a receding mandible are listed.

Genetics 4-6, slide 120 · Autosomal syndromes (Down, Patau, Edwards, cri-du-chat) · Hard

458. Which features are listed for Down syndrome?

A Cleft lip, polydactyly, heart defects and unusually small eyes

B Short stature, eyelid fold, flat face and stubby fingers

C Webbed neck, shield-shaped chest and short stature

D Low birth weight, a small head and a high cat-like cry

> **Answer 458: B**
>
> Correct. These are the listed Down syndrome features.

Genetics 4-6, slide 149 · Autosomal syndromes (Down, Patau, Edwards, cri-du-chat) · Hard

459. How many chromosomes does a person with Down syndrome (47, +21) have, and how many copies of chromosome 21?

A 46 chromosomes, with three copies of chromosome 21

B 47 chromosomes, with three copies of chromosome 21

C 47 chromosomes, with two copies of chromosome 21

D 45 chromosomes, with one copy of chromosome 21

> **Answer 459: B**
>
> Correct. 46 plus one extra 21 gives 47 with three copies.

Genetics 4-6, slide 153 · Autosomal syndromes (Down, Patau, Edwards, cri-du-chat) · Devil

460. Which pairing of syndrome, karyotype and chromosome is correct?

A Edwards: 47, +13; trisomy 13

B Down: 47, +18; trisomy 18

C Patau: 47, +13; trisomy 13

D Patau: 47, +21; trisomy 21

> **Answer 460: C**
>
> Correct. Patau syndrome is 47, +13.

Genetics 4-6, slide 149 · Autosomal syndromes (Down, Patau, Edwards, cri-du-chat) · Devil

461. Which statement correctly contrasts Down syndrome and cri-du-chat syndrome?

A Both are trisomies, each affecting chromosome number 5

B Down is a deletion of part of 21; cri-du-chat is a trisomy of chromosome 5

C Both are deletions affecting part of chromosome number 21

D Down is a trisomy of 21; cri-du-chat is a deletion on chromosome 5

> **Answer 461: D**
>
> Correct. One is numerical and the other is structural.

Genetics 4-6, slide 153 · Autosomal syndromes (Down, Patau, Edwards, cri-du-chat) · Devil

462. The incidence of Down, Edwards and Patau syndromes is 1 in 700, 1 in 10,000 and 1 in 20,000. Which order matches (most common first)?

A Down, Edwards, Patau

B Patau, Edwards, Down

C Edwards, Down, Patau

D Down, Patau, Edwards

> **Answer 462: A**
>
> Correct. Smaller denominators mean higher frequency.

Genetics 4-6, slide 134 · Autosomal syndromes (Down, Patau, Edwards, cri-du-chat) · Devil

463. Cri-du-chat syndrome is caused by a heterozygous deficiency of the short arm of chromosome 5. What does this imply?

A One homologue has the deletion and the other is normal

B Both homologues carry the deletion of the same segment

C Chromosome 5 is entirely absent from every cell of the body

D An extra copy of chromosome 5 is present in the cell

> **Answer 463: A**
>
> Correct. Heterozygous means one normal and one deleted homologue.

5. Sex chromosome syndromes

Genetics 4-6, slide 161 · Sex chromosome syndromes · Easy

464. What is the karyotype of Turner syndrome?

A 47, XXY
B 45, X
C 47, XYY
D 47, XXX

> **Answer 464: B**
> Correct. Turner syndrome has one X and no Y.

Genetics 4-6, slide 166 · Sex chromosome syndromes · Easy

465. What is the karyotype of Klinefelter syndrome?

A 45, X
B 47, XYY
C 47, +21
D 47, XXY

> **Answer 465: D**
> Correct. Klinefelter syndrome is XXY.

Genetics 4-6, slide 161 · Sex chromosome syndromes · Medium

466. Turner syndrome is the only known viable form of which condition in humans?

A Trisomy
B Triploidy
C Monosomy
D Tetraploidy

> **Answer 466: C**
> Correct. 45, X is the only viable human monosomy.

Genetics 4-6, slide 161 · Sex chromosome syndromes · Medium

467. About how common is Turner syndrome among live female births?

A About 1 in 100
B About 1 in 10,000
C About 1 in 700
D About 1 in 20

> **Answer 467: B**
> Correct. The lecture gives 1 in 10,000.

Genetics 4-6, slide 165 · Sex chromosome syndromes · Medium

468. Which features are listed for Turner syndrome?

A Cleft lip, polydactyly and severe heart defects

B Taller than average, fertile and sexually mature early

C A webbed or broad neck and a shield-like chest

D Eyelid fold, a flat face and short stubby fingers

> **Answer 468: C**
>
> Correct. Webbed neck and broad chest are listed.

Genetics 4-6, slide 166 · Sex chromosome syndromes · Medium

469. At what frequency are Klinefelter (XXY) males born?

A About 1.3%

B About 13%

C About 0.0013%

D About 0.13%

> **Answer 469: D**
>
> Correct. The lecture gives 0.13%.

Genetics 4-6, slide 171 · Sex chromosome syndromes · Medium

470. At what frequency are XYY males born?

A About 0.15%

B About 1.5%

C About 15%

D About 0.015%

> **Answer 470: A**
>
> Correct. The lecture gives 0.15%.

Genetics 4-6, slide 162 · Sex chromosome syndromes · Hard

471. In what proportion of Turner syndrome cases is the X chromosome maternal?

A About 25%

B About 50%

C About 75%

D About 100%

> **Answer 471: C**
>
> Correct. In 75% of cases the maternal X is present.

Genetics 4-6, slide 162 · Sex chromosome syndromes · Hard

472. What proportion of 45, X conceptions abort spontaneously?

A About 10%

B About 50%

C Almost none

D More than 90%

> **Answer 472: D**
>
> Correct. The lecture says more than 90%.

Genetics 4-6, slide 164 · Sex chromosome syndromes · Hard

473. Which features describe adults with Turner syndrome?

A Fertility, taller height and normal secondary sexual development

B Normal life expectancy, sterility and limited sexual development

C Early death in infancy in almost every affected child

D Male external genitalia and a normal male fertility

> **Answer 473: B**
>
> Correct. These features are listed.

Genetics 4-6, slide 167 · Sex chromosome syndromes · Hard

474. How can nondisjunction in the male produce an XXY zygote?

A Meiosis I nondisjunction gives an XY sperm that fertilizes an X egg

B An X sperm fertilizes an egg that carries an X and a Y chromosome

C A Y sperm fertilizes an egg that carries only a Y chromosome

D An XX sperm fertilizes an egg that carries a single Y chromosome

> **Answer 474: A**
>
> Correct. An XY sperm plus an X ovum gives XXY.

Genetics 4-6, slide 168 · Sex chromosome syndromes · Hard

475. How can nondisjunction in the female produce an XXY zygote?

A A Y ovum is fertilized by an X sperm

B An XX ovum is fertilized by a normal Y sperm

C An XY ovum is fertilized by an X sperm

D An O ovum is fertilized by an XY sperm

> **Answer 475: B**
>
> Correct. XX plus Y gives XXY.

Genetics 4-6, slide 171 · Sex chromosome syndromes · Hard

476. How can XYY males arise?

A From nondisjunction of the Y chromatids at meiosis II

B From nondisjunction of the X chromatids in meiosis I

C From nondisjunction of the Y chromosome in mitosis only

D From the loss of one autosome from the early zygote

> **Answer 476: A**
>
> Correct. Y chromatids fail to separate at meiosis II.

Genetics 4-6, slide 171 · Sex chromosome syndromes · Hard

477. Which features describe XYY males in the lecture?

A Sterile males with enlarged breasts and reduced testes in adulthood

B Short stature with a webbed neck and a shield-like chest

C Female with no ovaries and little sexual development

D Taller than average, sexually mature early and completely fertile

> **Answer 477: D**
>
> Correct. XYY males are tall and fertile.

Genetics 4-6, slide 159 · Sex chromosome syndromes · Devil

478. How does the effect of sex chromosome aneuploidy generally compare with autosomal aneuploidy?

A It is always more deleterious

B It is always lethal

C It is less deleterious

D It never occurs

> **Answer 478: C**
>
> Correct. Sex chromosome aneuploidy is less harmful.

Genetics 4-6, slide 170 · Sex chromosome syndromes · Devil

479. Which statement about Klinefelter males is correct?

A Males with male genitalia who are sterile and may show feminine traits

B They are fully fertile males and develop no female traits of any kind

C They are females who have ovaries and normal fertility

D They almost always die in infancy or early childhood

> **Answer 479: A**
>
> Correct. The lecture notes male development with sterility and some feminine traits.

Genetics 4-6, slide 162 · Sex chromosome syndromes · Devil

480. A Turner syndrome individual may arise if an X sperm fertilizes an ovum with no X. Which parent shows nondisjunction?

A The father

B Both parents necessarily

C Neither parent

D The mother

> **Answer 480: D**
>
> Correct. The ovum lacks an X because of maternal nondisjunction.

Genetics 4-6, slide 160 · Sex chromosome syndromes · Devil

481. Which three sex chromosome conditions are described as comparatively common?

A XXXX females, XO males and YY males

B XXY females, XYY females and XO males

C XO females, XXY males and XYY males

D XX males, XY females and XXX males

> **Answer 481: C**
>
> Correct. These three are the common ones.

6. Amniocentesis and viability of aneuploids

Genetics 4-6, slide 151 · Amniocentesis and viability of aneuploids · Easy

482. What procedure is used to obtain fetal cells for karyotyping?

A Mitosis

B Amniocentesis

C Fertilization

D Colchicine therapy

> **Answer 482: B**
>
> Correct. Amniocentesis draws fluid from the amniotic sac.

Genetics 4-6, slide 152 · Amniocentesis and viability of aneuploids · Medium

483. From where is the sample drawn in amniocentesis?

A The placenta only

B The mother's blood only

C The fetal bone

D The amniotic sac

> **Answer 483: D**
>
> Correct. A needle draws fluid from the amniotic sac.

Genetics 4-6, slide 152 · Amniocentesis and viability of aneuploids · Medium

484. About how long are fetal cells cultured before chromosomes are stained and observed?

A About three hours

B About three days

C About three weeks

D About three months

> **Answer 484: C**
>
> Correct. The lecture gives about three weeks.

Genetics 4-6, slide 152 · Amniocentesis and viability of aneuploids · Hard

485. What finding on a karyotype confirms Down syndrome?

A Two number 21 chromosomes

B Three number 21 chromosomes

C One X chromosome only

D Two number 13 chromosomes

> **Answer 485: B**
>
> Correct. Three copies of chromosome 21 confirm Down syndrome.

Genetics 4-6, slide 125 · Amniocentesis and viability of aneuploids · Hard

486. About what percentage of spontaneous abortuses with chromosomal abnormalities are aneuploid?

A About 65%

B About 5%

C About 25%

D About 95%

> **Answer 486: A**
>
> Correct. The lecture says 65%.

Genetics 4-6, slide 126 · Amniocentesis and viability of aneuploids · Hard

487. Which aneuploid condition has the highest incidence among abortuses?

A 47, +21

B 47, +13

C 45, X

D 47, XYY

> **Answer 487: C**
>
> Correct. 45, X is the most frequent.

Genetics 4-6, slide 124 · Amniocentesis and viability of aneuploids · Devil

488. What do reduced viability and karyotypes of aborted fetuses suggest?

A Aneuploid conditions never arise in any human pregnancy at all

B Many aneuploid conditions arise but do not survive to term

C All aneuploid fetuses survive through to a normal birth

D Aneuploidy only ever affects the placenta, never the fetus

> **Answer 488: B**
>
> Correct. Many aneuploid fetuses are lost before birth.

Genetics 4-6, slide 152 · Amniocentesis and viability of aneuploids · Devil

489. A culture of fetal cells shows 47 chromosomes with three number 21 chromosomes. Which karyotype notation fits?

A 47, +21

B 47, +18

C 46, +21

D 45, X

> **Answer 489: A**
>
> Correct. 46 plus an extra 21 gives 47, +21.

Module 7: Sex determination and sex linkage — 73 questions

1. Chromosomal mechanisms (XY, ZW, XO)

Module 4-10, slide 6 · Chromosomal mechanisms (XY, ZW, XO) · Easy

490. Which four chromosomal sex-determining mechanisms does the lecture name?

A XY, XX, YY and ZZ

B Haploid, diploid, triploid and tetraploid

C Autosomal, mitochondrial, plastid and nuclear

D XY, ZW, XO and compound mechanisms

> **Answer 490: D**
>
> Correct. The lecture lists XY, ZW, XO and compound mechanisms.

Module 4-10, slide 8 · Chromosomal mechanisms (XY, ZW, XO) · Easy

491. In humans, which sex is heterogametic?

A Females (XX)

B Males (XY)

C Both sexes

D Neither sex

> **Answer 491: B**
>
> Correct. Males make X and Y gametes.

Module 4-10, slide 9 · Chromosomal mechanisms (XY, ZW, XO) · Medium

492. What does a normal human female carry?

A 22 pairs of autosomes plus two X chromosomes

B 22 pairs of autosomes plus an X and a Y chromosome

C 23 pairs of autosomes plus a single X chromosome

D 44 pairs of autosomes plus two X chromosomes

> **Answer 492: A**
>
> Correct. Females have 22 pairs of autosomes and XX.

Module 4-10, slide 9 · Chromosomal mechanisms (XY, ZW, XO) · Medium

493. Why are human females called the homogametic sex?

A They have no sex chromosomes in any of their body cells

B They have two clearly different sex chromosomes, X and Y

C They produce only one kind of gamete for sex chromosomes

D They produce no gametes of any kind in their ovaries

> **Answer 493: C**
>
> Correct. Every egg carries an X.

Module 4-10, slide 7 · Chromosomal mechanisms (XY, ZW, XO) · Medium

494. What term describes the unequal pair of sex chromosomes (X and Y) in humans and most mammals?

A Homologous

B Haploid

C Acentric

D Heteromorphic

> **Answer 494: D**
>
> Correct. X and Y differ in form, so they are heteromorphic.

Module 4-10, slide 14 · Chromosomal mechanisms (XY, ZW, XO) · Medium

495. In the ZW system, which sex is heterogametic?

A Males (ZZ)

B Both sexes

C Neither sex

D Females (ZW)

> **Answer 495: D**
>
> Correct. In ZW systems females are ZW.

Module 4-10, slide 14 · Chromosomal mechanisms (XY, ZW, XO) · Hard

496. Which groups use the ZW sex-determining mechanism?

A Humans and most other mammals, including cattle

B Honeybees and wasps, which have haplodiploid males

C Most birds, butterflies, moths and some fish

D Turtles and lizards, which can use temperature

> **Answer 496: C**
>
> Correct. These groups have heterogametic females.

Module 4-10, slide 8 · Chromosomal mechanisms (XY, ZW, XO) · Hard

497. In the XY system, which parent determines the sex of the offspring?

A The mother, through an egg that carries a Y chromosome

B The father, through an X-bearing or Y-bearing sperm

C Neither parent, since only chance alone decides sex

D Both parents equally through their acquired traits

> **Answer 497: B**
>
> Correct. The sperm supplies X or Y.

Module 4-10, slide 14 · Chromosomal mechanisms (XY, ZW, XO) · Hard

498. In the ZZ-ZW system, which parent determines the sex of the offspring?

A The mother, through a Z-bearing or W-bearing egg

B The father, through a sperm that carries a W chromosome

C Neither parent, since only chance alone decides the sex

D The environment alone, with no role for chromosomes

> **Answer 498: A**
>
> Correct. The heterogametic female supplies Z or W.

Module 4-10, slide 10 · Chromosomal mechanisms (XY, ZW, XO) · Hard

499. A human female (XX) mates with a human male (XY). What offspring sex ratio is expected?

A 1 female : 1 male

B All females

C All males

D 3 females : 1 male

> **Answer 499: A**
>
> Correct. The father gives X or Y with equal chance.

Module 4-10, slide 11 · Chromosomal mechanisms (XY, ZW, XO) · Hard

500. What does the Y chromosome mainly contain in Drosophila?

A The main female-determining genes

B The male-determining genes for sex determination

C Genes active in forming sperm in adults

D The genes for white eyes

> **Answer 500: C**
>
> Correct. The Y has no significant role in sex determination in Drosophila.

Module 4-10, slide 8 · Chromosomal mechanisms (XY, ZW, XO) · Hard

501. Which statement about the heterogametic sex is correct?

A It produces only one kind of gamete for the sex chromosomes

B It produces two kinds of gametes for the sex chromosomes

C It has two identical sex chromosomes in its body cells

D It has no sex chromosomes in any cell of its body or gametes

> **Answer 501: B**
>
> Correct. In humans the male makes X and Y gametes.

Module 4-10, slide 8 · Chromosomal mechanisms (XY, ZW, XO) · Devil

502. How many autosomes does a normal human male carry?

A 22

B 46

C 23

D 44

> **Answer 502: D**
> Correct. 22 pairs of autosomes give 44.

Module 4-10, slide 14 · Chromosomal mechanisms (XY, ZW, XO) · Devil

503. A bird egg carrying W is fertilized by a sperm carrying Z. What is the sex of the chick?

A Male (ZZ)

B Female (WW)

C Female (ZW)

D Male (ZW)

> **Answer 503: C**
> Correct. ZW is female in birds.

Module 4-10, slide 8 · Chromosomal mechanisms (XY, ZW, XO) · Devil

504. A male mammal makes X- and Y-bearing sperm in equal numbers. What fraction of zygotes are XY?

A One half

B One quarter

C All of them

D None of them

> **Answer 504: A**
> Correct. Half the sperm carry Y.

Module 4-10, slide 14 · Chromosomal mechanisms (XY, ZW, XO) · Devil

505. How do mammals and birds differ in which sex is heterogametic?

A Mammals have heterogametic females (XX); birds have heterogametic males (ZZ)

B Mammals: heterogametic males (XY); birds: heterogametic females (ZW)

C Both mammals and birds have heterogametic males, with XY sex chromosomes

D Both mammals and birds have heterogametic females, with ZW sex chromosomes

> **Answer 505: B**
> Correct. XY males and ZW females are the two systems.

2. The Y chromosome, SRY and TDF

Module 4-10, slide 12 · The Y chromosome, SRY and TDF · Easy

506. Which gene on the Y chromosome is linked to testis development in mammals?

A TDF-X

B Sxl

C tra

D SRY

> **Answer 506: D**
>
> Correct. The SRY gene is on the short arm of the Y chromosome.

Module 4-10, slide 12 · The Y chromosome, SRY and TDF · Medium

507. What does SRY stand for?

A Sperm Region Y

B Sex Reversal Yeast

C Single Region Y

D Sex-determining Region Y

> **Answer 507: D**
>
> Correct. SRY is the Sex-determining Region Y gene.

Module 4-10, slide 12 · The Y chromosome, SRY and TDF · Medium

508. What gene product does SRY encode?

A Testis-determining factor (TDF)

B The sex-lethal protein of Drosophila

C The doublesex protein of Drosophila

D The transformer protein of Drosophila

> **Answer 508: A**
>
> Correct. The SRY gene encodes the testis-determining factor, TDF.

Module 4-10, slide 12 · The Y chromosome, SRY and TDF · Hard

509. On which part of the Y chromosome is SRY located?

A The long arm

B The short arm

C The centromere

D The X-homologous region

> **Answer 509: B**
>
> Correct. SRY is on the short arm of the Y.

Module 4-10, slide 13 · The Y chromosome, SRY and TDF · Hard

510. What does it mean that SRY is highly conserved in mammals?

A It has been lost from most of the mammal species

B It differs completely from one mammal species to another

C It is very similar in different mammal species

D It is only ever found in humans and no other mammal

> **Answer 510: C**
>
> Correct. Highly conserved means little change across species.

Module 4-10, slide 13 · The Y chromosome, SRY and TDF · Hard

511. What does SRY, with other genes, encode to promote testicular development?

A A hormone made in the ovary that promotes female development

B A DNA-binding protein activating testicular development genes

C A cell wall protein found only in the cells of plants

D A spindle fibre protein that moves the chromosomes in mitosis

> **Answer 511: B**
>
> Correct. The protein switches on genes for testicular development.

Module 4-10, slide 7 · The Y chromosome, SRY and TDF · Devil

512. What determines maleness in humans according to the lecture?

A The absence of an X chromosome

B The number of autosomes

C The temperature during development

D The presence of the Y chromosome

> **Answer 512: D**
>
> Correct. In humans the Y determines maleness.

Module 4-10, slide 11 · The Y chromosome, SRY and TDF · Devil

513. In which animal does the Y chromosome play no significant role in sex determination despite being present in males?

A Drosophila

B Humans

C All mammals

D Birds

> **Answer 513: A**
>
> Correct. In Drosophila the X:A ratio decides sex.

3. Genic balance in Drosophila

Module 4-10, slide 18 · Genic balance in Drosophila · Easy

514. What X:A ratio produces a normal diploid female Drosophila (2X:2A)?

A 0.5
B 0.67
C 1.0
D 1.5

> **Answer 514: C**
> Correct. 2X:2A gives a ratio of 1.0.

Module 4-10, slide 17 · Genic balance in Drosophila · Medium

515. What X:A ratio produces a normal diploid male Drosophila?

A 1.0
B 0.67
C 0.5
D 2.0

> **Answer 515: C**
> Correct. One X over two autosome sets gives a ratio of 0.5.

Module 4-10, slide 15 · Genic balance in Drosophila · Medium

516. According to Bridges, where are the female and male determinants in Drosophila?

A Female determiners on the autosomes; male determiners on the X chromosomes
B Both sets of determiners lie on the X chromosomes alone
C Both sets of determiners lie on the Y chromosome alone
D Female determiners on X chromosomes; male determiners on autosomes

> **Answer 516: D**
> Correct. The balance of X and autosomes determines sex.

Module 4-10, slide 18 · Genic balance in Drosophila · Medium

517. What is the sex of a fly with 2X and 3 sets of autosomes (2X:3A, ratio 0.67)?

A Normal female
B Intersex
C Normal male
D Metafemale

> **Answer 517: B**
> Correct. A ratio of 0.67 gives an intersex.

Module 4-10, slide 19 · Genic balance in Drosophila · Hard

518. A Drosophila has 3X and 2 sets of autosomes. What is its X:A ratio and sex?

A 1.50; metafemale

B 0.67; normal female

C 2.00; normal male

D 1.00; metamale

> **Answer 518: A**
>
> Correct. 3/2 = 1.50, which gives a metafemale (superfemale).

Module 4-10, slide 19 · Genic balance in Drosophila · Hard

519. A Drosophila has 1X and 3 sets of autosomes. What is its X:A ratio and sex?

A 3.00; normal female

B 0.33; metamale

C 0.67; normal male

D 0.25; metafemale (superfemale)

> **Answer 519: B**
>
> Correct. 1/3 = 0.33, which gives a metamale.

Module 4-10, slide 19 · Genic balance in Drosophila · Hard

520. A Drosophila has 4X and 2 sets of autosomes. What is its X:A ratio and sex?

A 0.50; normal female

B 2.50; normal male

C 2.00; metafemale

D 1.33; metamale

> **Answer 520: C**
>
> Correct. 4/2 = 2.00, which gives a metafemale (superfemale).

Module 4-10, slide 19 · Genic balance in Drosophila · Hard

521. A Drosophila has 3X and 3 sets of autosomes. What is its X:A ratio and sex?

A 1.17; normal male

B 1.33; metafemale (superfemale)

C 0.75; metamale

D 1.00; normal female

> **Answer 521: D**
>
> Correct. 3/3 = 1.00, which gives a normal female.

Module 4-10, slide 19 · Genic balance in Drosophila · Hard

522. A Drosophila has 2X and 4 sets of autosomes. What is its X:A ratio and sex?

A 0.50; normal male

B 2.00; normal female

C 0.75; metafemale (superfemale)

D 0.40; metamale

> **Answer 522: A**
> Correct. 2/4 = 0.50, which gives a normal male.

Module 4-10, slide 19 · Genic balance in Drosophila · Hard

523. A Drosophila has 1X and 4 sets of autosomes. What is its X:A ratio and sex?

A 4.00; normal female

B 0.50; normal male

C 0.20; metafemale (superfemale)

D 0.25; metamale

> **Answer 523: D**
> Correct. 1/4 = 0.25, which gives a metamale.

Module 4-10, slide 19; general · Genic balance in Drosophila · Hard

524. A Drosophila has 3X and 4 sets of autosomes. What is its X:A ratio and sex?

A 1.33; normal female

B 1.00; normal male

C 0.75; intersex

D 0.60; metafemale (superfemale)

> **Answer 524: C**
> Correct. 3/4 = 0.75, which gives a intersex.

Module 4-10, slide 18 · Genic balance in Drosophila · Devil

525. A fly has two X chromosomes, one Y and two sets of autosomes (XXY;2A). What is its sex, and why?

A Normal female, since X:A is 1.0 and the Y does not decide sex

B Male, since it carries a Y chromosome in all of its cells

C Intersex, since it has three sex chromosomes in each cell

D Metafemale, since it carries an extra sex chromosome of any kind

> **Answer 525: A**
> Correct. In Drosophila the ratio, not the Y, determines sex.

Module 4-10, slide 18 · Genic balance in Drosophila · Devil

526. What does the metamale (XY;3A) example show?

A A ratio of about 1.0 produces a metamale

B A ratio of about 0.33 produces a sterile metamale

C A ratio of about 2.0 produces a metamale

D The Y chromosome alone makes a metamale

> **Answer 526: B**
>
> Correct. 1X:3A gives a ratio below 0.5.

Module 4-10, slide 19 · Genic balance in Drosophila · Devil

527. Why does the genic balance theory predict sterility in intersexes, metafemales and metamales?

A Abnormal X:A balance disrupts sex-specific gene expression

B They have no sex chromosomes in any of their body cells or gametes

C They have no autosomes in any of their body cells

D They are always haploid in every cell of the body

> **Answer 527: A**
>
> Correct. The abnormal balance disturbs gene expression.

Module 4-10, slide 21 · Genic balance in Drosophila · Devil

528. How does the X:A ratio determine sex at the molecular level, according to the lecture?

A By changing the chromosome number during each mitotic division

B By cutting the Y chromosome into smaller pieces in embryos

C By switching on sex-lethal, transformer and doublesex genes

D By deleting the autosomes from the cells of the early embryo

> **Answer 528: C**
>
> Correct. The ratio activates sex-specific gene expression.

Module 4-10, slide 17 · Genic balance in Drosophila · Devil

529. Why is a fly with X:A = 0.5 a normal male even if its autosome and X number is doubled (2X:4A)?

A Because tetraploid flies are always male, whatever the X:A ratio happens to be

B Because the Y chromosome is present in the male fly

C Because two X chromosomes always make males in Drosophila

D Because it is the ratio, not the absolute number, that decides sex

> **Answer 529: D**
>
> Correct. 2/4 = 0.5, the male ratio.

4. Haplodiploidy and environmental sex determination

Module 4-10, slide 22 · Haplodiploidy and environmental sex determination · Easy

530. What is the chromosome number of a drone honeybee?

A 32 (diploid)

B 16 (haploid)

C 8 (quarter set)

D 64 (tetraploid)

> **Answer 530: B**
>
> Correct. Drones are haploid with 16 chromosomes.

Module 4-10, slide 22 · Haplodiploidy and environmental sex determination · Medium

531. From what kind of egg does a male honeybee develop?

A A fertilized egg

B A diploid egg only

C An egg fertilized by two sperm

D An unfertilized egg

> **Answer 531: D**
>
> Correct. Males develop parthenogenetically from unfertilized eggs.

Module 4-10, slide 23 · Haplodiploidy and environmental sex determination · Medium

532. What is the chromosome number of the queen and workers of the honeybee?

A 32 (diploid)

B 16 (haploid)

C 8

D 64

> **Answer 532: A**
>
> Correct. They arise from fertilized eggs.

Module 4-10, slide 23 · Haplodiploidy and environmental sex determination · Medium

533. In the wasp Bracon hebetor, how many chromosomes do females and males have?

A Females 10 (haploid); males 20 (diploid)

B Females 20 (diploid); males 10 (haploid)

C Females 20 (diploid); males 20 (also diploid)

D Females 10 (haploid); males 10 (haploid)

> **Answer 533: B**
>
> Correct. Females are diploid and males haploid.

Module 4-10, slide 24 · Haplodiploidy and environmental sex determination · Hard

534. What is the term for sex determination in which males are haploid and females diploid?

A Heterogamety

B Genic balance

C Haplodiploidy

D Mosaicism

> **Answer 534: C**
> Correct. Haplodiploidy describes this mechanism.

Module 4-10, slide 27 · Haplodiploidy and environmental sex determination · Hard

535. What happens to the sex of turtle (Chrysemys picta) offspring at high incubation temperature?

A Mostly males result

B All offspring die

C Sex is unchanged

D Mostly females result

> **Answer 535: D**
> Correct. High temperature gives mostly female turtles.

Module 4-10, slide 27 · Haplodiploidy and environmental sex determination · Hard

536. What happens to the sex of lizard (Agama agama) offspring at high incubation temperature?

A Mostly females result

B Mostly males result

C All offspring are intersex

D Sex is unchanged

> **Answer 536: B**
> Correct. High temperature gives mostly male lizards.

Module 4-10, slide 25 · Haplodiploidy and environmental sex determination · Devil

537. What is a gynandromorph?

A An insect whose body has both female and male parts

B A haploid male insect such as a drone honeybee

C A fully sterile female insect found in a honeybee colony

D A fly with an X:A ratio of 1.0 and two X chromosomes

> **Answer 537: A**
> Correct. Abnormal chromosome behaviour can produce sexual mosaics.

Module 4-10, slide 26 · Haplodiploidy and environmental sex determination · Devil

538. Why can males and females of some lower animals have similar genotypes?

A They have identical sex chromosomes in both males and females, so sex cannot differ

B They have no genes at all that could affect their sex

C Their sex is set by environmental stimuli rather than by genes

D They are always haploid in both of the sexes at all times

> **Answer 538: C**
>
> Correct. In non-genetic sex determination the environment initiates the sex.

Module 4-10, slide 23 · Haplodiploidy and environmental sex determination · Devil

539. A Bracon hebetor egg is fertilized. What is the sex of the offspring and its chromosome number?

A Male, with 10 chromosomes

B Female, with 20 chromosomes

C Female, with 10 chromosomes

D Male, with 20 chromosomes

> **Answer 539: B**
>
> Correct. Females arise from fertilized eggs and are diploid.

5. Sex linkage: Morgan's discovery

Module 4-10, slide 31 · Sex linkage: Morgan's discovery · Easy

540. Who discovered sex linkage in Drosophila using a white-eyed mutant?

A T. H. Morgan

B G. Mendel

C C. B. Bridges

D H. Henking

> **Answer 540: A**
>
> Correct. Morgan found a white-eyed mutant in a culture of red-eyed flies.

Module 4-10, slide 32 · Sex linkage: Morgan's discovery · Medium

541. In Morgan's cross of a white-eyed male with a red-eyed female, what did the F1 look like?

A All white-eyed

B Half red and half white

C White-eyed males only

D All red-eyed

> **Answer 541: D**
>
> Correct. All F1 flies had red eyes.

Module 4-10, slide 32 · Sex linkage: Morgan's discovery · Medium

542. What F2 ratio of red to white eyes did Morgan find?

A 1 red : 1 white

B All white

C About 3 red : 1 white

D All red

> **Answer 542: C**
>
> Correct. The F2 included red and white flies in about 3:1.

Module 4-10, slide 34 · Sex linkage: Morgan's discovery · Medium

543. What was unusual about the white-eyed flies in Morgan's F2 generation?

A All of them were females

B They were all sterile

C They had no X chromosome

D All of them were males

> **Answer 543: D**
>
> Correct. Only males had white eyes.

Module 4-10, slide 34 · Sex linkage: Morgan's discovery · Hard

544. In Morgan's F2 generation, what were the eye colours of the females and the males?

A All females white-eyed; all of the males red-eyed

B Half the females white-eyed; every one of the males white-eyed

C All females red; about half the males red and half white

D All of the flies red-eyed, both males and females

> **Answer 544: C**
>
> Correct. The recessive allele showed only in males.

Module 4-10, slide 35 · Sex linkage: Morgan's discovery · Hard

545. How did Morgan explain that the recessive white allele showed up only in males?

A He associated the gene with the X chromosome

B He associated it with the Y chromosome

C He associated it with the mitochondria

D He associated it with the autosomes

> **Answer 545: A**
>
> Correct. He linked the allele to the X chromosome.

Module 4-10, slide 36 · Sex linkage: Morgan's discovery · Hard

546. How does the lecture describe the sex chromosomes of female and male Drosophila?

A Females: an X and a J-shaped Y; males: two rod-shaped chromosomes

B Females: two rod-shaped Xs; males: one X and a J-shaped Y

C Both sexes have two rod-shaped X chromosomes in each cell

D Both sexes have a J-shaped Y chromosome in each cell

> **Answer 546: B**
>
> Correct. XX females and XY males, with the Y J-shaped.

Module 4-10, slide 37 · Sex linkage: Morgan's discovery · Devil

547. Which statement best explains why Morgan's result was a natural consequence of Mendelian assortment of chromosomes?

A The white allele is on an autosome and segregates independently of sex

B The white allele is in the mitochondria and inherited from the mother

C The white allele moves back and forth between the X and Y

D The white allele lies on the X, which segregates with the sexes

> **Answer 547: D**
>
> Correct. Assortment of X and Y explains the sex-limited pattern.

Module 4-10, slide 35 · Sex linkage: Morgan's discovery · Devil

548. In Morgan's experiment, what does it mean that the recessive allele "was expressed only in males"?

A Males carry two X chromosomes and no Y chromosome at all

B Females have no X chromosomes in their body cells

C Males carry one X, so one recessive allele shows the trait

D Males are heterozygous for the white allele on their X chromosome

> **Answer 548: C**
>
> Correct. Males are hemizygous for X-linked genes.

6. Sex-linked inheritance and crosses

Module 4-10, slide 38 · Sex-linked inheritance and crosses · Easy

549. A white-eyed female (X^w X^w) is crossed with a white-eyed male (X^w Y). What eye colour do the offspring have?

A All red-eyed

B All white-eyed

C Daughters red, sons white

D Half red and half white

> **Answer 549: B**
>
> Correct. Every offspring inherits only w alleles.

Module 4-10, slide 38 · Sex-linked inheritance and crosses · Medium

550. A red-eyed female (X^W X^W) is crossed with a white-eyed male (X^w Y). What are the offspring?

A All red-eyed; the daughters are carriers

B All of the offspring are white-eyed, sons and daughters

C Daughters are white-eyed and the sons are red-eyed

D Half red-eyed and half white-eyed in both sexes

> **Answer 550: A**
>
> Correct. Daughters are X^W X^w and sons X^W Y.

Module 4-10, slide 38 · Sex-linked inheritance and crosses · Medium

551. A white-eyed female (X^w X^w) is crossed with a red-eyed male (X^W Y). What are the offspring?

A All of the offspring red-eyed, sons and daughters

B Daughters red-eyed (carriers), sons white-eyed

C All of the offspring white-eyed, sons and daughters

D Daughters are white-eyed and the sons are red-eyed

> **Answer 551: B**
>
> Correct. Sons get the mother's X^w and daughters get X^W from the father.

Module 4-10, slide 38 · Sex-linked inheritance and crosses · Medium

552. How does a sex-linked recessive trait usually appear in a population?

A More often in females than in males, in most families

B Equally often in both males and females in every family

C More often in males than in females

D Only in females, and never in any of the males

> **Answer 552: C**
>
> Correct. Males need only one recessive allele.

Module 4-10, slide 34 · Sex-linked inheritance and crosses · Hard

553. A carrier red-eyed female (X^W X^w) is crossed with a red-eyed male (X^W Y). What are the offspring?

A All daughters red-eyed; half the sons white-eyed

B All daughters white-eyed and all of the sons red-eyed

C All sons red-eyed and half of the daughters white-eyed

D Half of the daughters white-eyed and no sons

> **Answer 553: A**
>
> Correct. Sons receive either X^W or X^w from the mother.

Module 4-10, slide 34 · Sex-linked inheritance and crosses · Hard

554. A carrier red-eyed female (X^W X^w) is crossed with a white-eyed male (X^w Y). What are the offspring?

A All daughters red-eyed and half the sons white-eyed

B All sons red-eyed and all daughters white-eyed

C All of the offspring white-eyed, in both sexes

D Half the daughters and half the sons white-eyed

> **Answer 554: D**
> Correct. Daughters are X^W X^w or X^w X^w; sons are X^W Y or X^w Y.

Module 4-10, slide 34 · Sex-linked inheritance and crosses · Hard

555. A carrier female (X^W X^w) is crossed with a red-eyed male (X^W Y) and produces 80 offspring. How many are expected to be white-eyed?

A 40

B 10

C 60

D 20

> **Answer 555: D**
> Correct. Half the sons are white; sons are half of 80, so 20.

Module 4-10, slide 34 · Sex-linked inheritance and crosses · Hard

556. From the same cross (X^W X^w × X^W Y, 80 offspring), how many carrier daughters are expected?

A 40

B 20

C 10

D 60

> **Answer 556: B**
> Correct. Daughters are 40; half are X^W X^w.

Module 4-10, slide 34 · Sex-linked inheritance and crosses · Hard

557. A white-eyed female (X^w X^w) is crossed with a red-eyed male (X^W Y). What fraction of all offspring are white-eyed?

A One half

B All

C None

D One quarter

> **Answer 557: A**
> Correct. All sons are white and sons are half of the offspring.

Module 4-10, slide 38 · Sex-linked inheritance and crosses · Hard

558. According to the lecture, when does a sex-linked recessive trait appear in a female?

A Only if her mother is unaffected and her father is a carrier

B Whenever her mother is a carrier of the allele

C Only if the trait also appeared in her father

D Never, since only males can ever show such a trait

> **Answer 558: C**
>
> Correct. A female needs a recessive allele from her father too.

Module 4-10, slide 40 · Sex-linked inheritance and crosses · Hard

559. An affected father (X^A Y) with a sex-linked dominant trait mates with an unaffected mother (X^a X^a). What is expected in the children?

A All sons affected and no daughters affected

B All daughters affected and no sons affected

C Half the sons and half the daughters affected

D No children affected

> **Answer 559: B**
>
> Correct. Daughters get the father's X^A; sons get his Y.

Module 4-10, slide 39 · Sex-linked inheritance and crosses · Devil

560. Which pattern is typical of a sex-linked dominant gene?

A It is found in all daughters of an affected father

B It is found in all of the sons of an affected father

C It never occurs in females, but only in males of the species

D It is passed from father to son only, never to daughters

> **Answer 560: A**
>
> Correct. An affected father passes his X to all daughters.

Module 4-10, slide 40 · Sex-linked inheritance and crosses · Devil

561. An unaffected mother has a son who does not show a sex-linked dominant trait. What does this tell you?

A All of the sons of this mother will also show the dominant trait

B The father of the child must be the affected parent here

C The mother must be a carrier of the dominant allele

D A mother not showing the trait does not pass it to her sons

> **Answer 561: D**
>
> Correct. Mothers who do not show a dominant sex-linked trait do not transmit it to sons.

562. A woman with a sex-linked recessive trait has a son. What does the lecture predict about the son?

A The son will be a carrier

B The son will be unaffected

C The son will show the trait

D The son has a 50% chance

> **Answer 562: C**
>
> Correct. A woman who shows a recessive sex-linked trait is X^w X^w and gives X^w to every son.

Module 8: Multiple alleles and blood groups — 97 questions

1. Multiple alleles and genotype counts

Module 4-10, slide 45 · Multiple alleles and genotype counts · Easy

563. What is the maximum number of alleles of one gene that a single diploid individual can carry?

A Two

B One

C Three

D As many as exist in the population

> **Answer 563: A**
>
> Correct. One allele sits on each homologous chromosome.

Module 4-10, slide 65 · Multiple alleles and genotype counts · Easy

564. How many different genotypes are possible with 3 alleles of a gene?

A 3

B 9

C 8

D 6

> **Answer 564: D**
>
> Correct. $n(n + 1)/2 = 3 \times 4/2 = 6$.

Module 4-10, slide 46 · Multiple alleles and genotype counts · Medium

565. What are more than two alleles at a gene locus in a population called?

A Codominant alleles

B Multiple alleles

C Lethal alleles

D Linked alleles

> **Answer 565: B**
>
> Correct. More than two alleles at a locus are multiple alleles.

Module 4-10, slide 46 · Multiple alleles and genotype counts · Medium

566. How do large numbers of alleles arise at a locus?

A By the loss of whole chromosomes during division

B By the fertilization of two eggs by a single sperm

C Genes change to alternative forms by mutation

D By the replication of the centrioles in the cell

> **Answer 566: C**
> Correct. Mutation creates alternative alleles.

Module 4-10, slide 65 · Multiple alleles and genotype counts · Medium

567. How many different genotypes are possible with 4 alleles of a gene?

A 10
B 8
C 12
D 16

> **Answer 567: A**
> Correct. $4 \times 5/2 = 10$.

Module 4-10, slide 65 · Multiple alleles and genotype counts · Hard

568. How many different genotypes are possible with 5 alleles of a gene?

A 10
B 15
C 20
D 25

> **Answer 568: B**
> Correct. $5 \times 6/2 = 15$.

Module 4-10, slide 65; general · Multiple alleles and genotype counts · Hard

569. A locus has 6 alleles in a population. How many different diploid genotypes are possible?

A 12
B 15
C 21
D 36

> **Answer 569: C**
> Correct. $6 \times 7/2 = 21$.

Module 4-10, slide 65; general · Multiple alleles and genotype counts · Hard

570. A locus has 8 alleles in a population. How many different diploid genotypes are possible?

A 28
B 64
C 16
D 36

> **Answer 570: D**
> Correct. $8 \times 9/2 = 36$.

Module 4-10, slide 65; general · Multiple alleles and genotype counts · Hard

571. A locus has 10 alleles in a population. How many different diploid genotypes are possible?

A 55
B 45
C 100
D 20

> **Answer 571: A**
> Correct. 10 × 11/2 = 55.

Module 4-10, slide 65; general · Multiple alleles and genotype counts · Hard

572. In a system with 4 alleles, how many of the possible genotypes are heterozygous?

A 4
B 10
C 12
D 6

> **Answer 572: D**
> Correct. 10 genotypes in total minus 4 homozygous leaves 6.

Module 4-10, slide 65; general · Multiple alleles and genotype counts · Hard

573. In a system with 5 alleles, how many of the possible genotypes are homozygous?

A 10
B 15
C 5
D 25

> **Answer 573: C**
> Correct. There is one homozygous genotype for each allele.

Module 4-10, slide 65 · Multiple alleles and genotype counts · Hard

574. A population has 6 alleles at a locus. Which statement about one diploid individual is correct?

A It carries all six of the alleles in its cells
B It carries at most two of the six alleles
C It carries only one allele of the six at all times
D It carries four of the six alleles at a time

> **Answer 574: B**
> Correct. Only two alleles can be present in any one diploid organism.

Module 4-10, slide 65; general · Multiple alleles and genotype counts · Devil

575. A locus has 12 alleles in a population. How many different diploid genotypes are possible?

A 78
B 66
C 144
D 24

> **Answer 575: A**
> Correct. 12 × 13/2 = 78.

Module 4-10, slide 65; general · Multiple alleles and genotype counts · Devil

576. In a system with 7 alleles, how many genotypes are heterozygous?

A 7
B 28
C 21
D 49

> **Answer 576: C**
> Correct. Total 28 genotypes minus 7 homozygous leaves 21.

Module 4-10, slide 65; general · Multiple alleles and genotype counts · Devil

577. How many alleles of a gene give a total of 45 possible genotypes?

A 8
B 9
C 10
D 15

> **Answer 577: B**
> Correct. 9 × 10/2 = 45.

Module 4-10, slide 65; general · Multiple alleles and genotype counts · Devil

578. How many alleles of a gene give a total of 66 possible genotypes?

A 10
B 12
C 33
D 11

> **Answer 578: D**
> Correct. 11 × 12/2 = 66.

2. Codominance and the MN blood group

Module 4-10, slide 47 · Codominance and the MN blood group · Easy

579. What does codominance mean?

A One allele hides the other completely in the heterozygote

B The heterozygote is intermediate between the two homozygotes

C Both alleles are fully expressed in the heterozygote

D One allele kills the carrier before it can reproduce

> **Answer 579: C**
> Correct. Both alleles are fully expressed.

Module 4-10, slide 48 · Codominance and the MN blood group · Medium

580. What antigens does an LMLN heterozygote carry on its red blood cells?

A Both M and N antigens

B Only M antigen

C Only N antigen

D Neither antigen

> **Answer 580: A**
> Correct. M and N are codominant.

Module 4-10, slide 49 · Codominance and the MN blood group · Medium

581. What phenotypic ratio is expected from LMLN × LMLN?

A 3 M : 1 N

B 1 M : 2 MN : 1 N

C 1 M : 1 N

D All MN

> **Answer 581: B**
> Correct. The ratio is 1:2:1.

Module 4-10, slide 48 · Codominance and the MN blood group · Medium

582. What are the two alleles of the MN blood group locus?

A IA and IB

B C and c

C W and w

D LM and LN

> **Answer 582: D**
> Correct. The alleles are LM and LN.

Module 4-10, slide 49 · Codominance and the MN blood group · Hard

583. Why does a 1:2:1 phenotypic ratio replace the 3:1 ratio in the MN cross?

A The heterozygote shows both alleles, so three phenotypes appear

B One of the alleles is lethal in the homozygous state and kills the embryo

C The two genes are tightly linked on the same chromosome

D The two alleles blend permanently into one new allele

> **Answer 583: A**
>
> Correct. Heterozygotes are distinguishable from both homozygotes.

Module 4-10, slide 49 · Codominance and the MN blood group · Hard

584. Two LMLN parents have 400 children. How many are expected to be group MN?

A 100

B 200

C 300

D 400

> **Answer 584: B**
>
> Correct. Half the children are heterozygous.

Module 4-10, slide 49 · Codominance and the MN blood group · Hard

585. What offspring are expected from LMLM × LMLN?

A All group M

B 1 group M : 1 group N

C 3 group M : 1 group N

D 1 group M : 1 group MN

> **Answer 585: D**
>
> Correct. LMLM gives LM; LMLN gives LM or LN.

Module 4-10, slide 49 · Codominance and the MN blood group · Hard

586. What offspring are expected from LNLN × LMLN?

A All group N

B 1 group M : 1 group MN

C 1 group MN : 1 group N

D All group MN

> **Answer 586: C**
>
> Correct. LNLN gives LN; LMLN gives LM or LN.

Module 4-10, slide 49 · Codominance and the MN blood group · Hard

587. What offspring are expected from LMLM × LNLN?

A All group M

B All group N

C All group MN

D 1 group M : 1 group N

> **Answer 587: C**
>
> Correct. Every child receives one LM and one LN.

Module 4-10, slide 49 · Codominance and the MN blood group · Devil

588. A child is group N. Which parental pairing is impossible?

A Both parents are of group MN (LMLN × LMLN)

B One parent of group MN and one of group N

C Both parents are of group N (LNLN × LNLN)

D Both parents group M (LMLM × LMLM)

> **Answer 588: D**
>
> Correct. Two LM LM parents cannot give an LN allele.

Module 4-10, slide 49 · Codominance and the MN blood group · Devil

589. A child is group MN. Which parental pairing is impossible?

A Both parents are of group MN (LMLN × LMLN)

B Both parents group N (LNLN × LNLN)

C One parent of group M and one of group N

D One parent of group MN and one of group M

> **Answer 589: B**
>
> Correct. Two LN LN parents cannot give an LM allele.

Module 4-10, slide 48 · Codominance and the MN blood group · Devil

590. Why can MN individuals be identified directly from their red cells?

A Both M and N antigens show, unlike either homozygote

B They have neither the M antigen nor the N antigen at all

C They have an extra chromosome in each of their cells

D They show only one antigen, chosen at random in each cell

> **Answer 590: A**
>
> Correct. Codominance makes heterozygotes distinguishable.

3. Incomplete dominance

Module 4-10, slide 51 · Incomplete dominance · Easy

591. What monohybrid phenotypic ratio results from incomplete dominance?

A 3:1

B 1:2:1

C 1:1

D 9:3:3:1

> **Answer 591: B**
>
> Correct. Every genotype has a distinguishable phenotype.

Module 4-10, slide 51 · Incomplete dominance · Medium

592. What is the heterozygote like under incomplete dominance?

A Identical to the dominant homozygote in every respect

B Identical to the recessive homozygote in every respect

C Lethal, so that the heterozygote dies before maturity

D Intermediate between the two homozygous phenotypes

> **Answer 592: D**
>
> Correct. The heterozygote shows an intermediate phenotype.

Module 4-10, slide 51 · Incomplete dominance · Medium

593. What does the lecture say about genotype and phenotype in the absence of complete dominance?

A Only homozygotes can be recognised by their phenotype

B Only heterozygotes can be recognised by their phenotype

C Every genotype has a distinguishable phenotype

D No phenotype can be seen for any of the genotypes

> **Answer 593: C**
>
> Correct. Three genotypes give three phenotypes.

Module 4-10, slide 51 · Incomplete dominance · Hard

594. Of 200 F2 offspring showing incomplete dominance, how many are expected to be intermediate?

A 100

B 50

C 150

D 200

> **Answer 594: A**
>
> Correct. The middle class is half of a 1:2:1 ratio.

Module 4-10, slide 51 · Incomplete dominance · Hard

595. What cross of an intermediate individual with a homozygous parent gives?

A All of the offspring intermediate in phenotype

B 1 intermediate : 1 homozygous like the parent

C All of the offspring like the homozygous parent

D 1 : 2 : 1 across the three possible phenotypes

> **Answer 595: B**
>
> Correct. The heterozygote makes two kinds of gametes equally.

Module 4-10, slide 47 · Incomplete dominance · Hard

596. How do codominance and incomplete dominance differ?

A Codominance shows both alleles; incomplete dominance gives a blend

B They are identical processes with two different names

C In codominance only one allele shows and the other is hidden

D In incomplete dominance both alleles show fully and unchanged

> **Answer 596: A**
>
> Correct. Codominant alleles are both expressed; incomplete dominance gives an intermediate product.

Module 4-10, slide 51 · Incomplete dominance · Devil

597. A cross gives 25 red, 52 intermediate and 23 white offspring. What is the best interpretation?

A Complete dominance, close to a 3:1 ratio

B A dihybrid cross giving a 9:3:3:1 ratio

C Incomplete dominance, close to 1:2:1

D Dominant epistasis, giving a 12:3:1 ratio

> **Answer 597: C**
>
> Correct. 25:52:23 is near 25:50:25.

Module 4-10, slide 51 · Incomplete dominance · Devil

598. Why does a 3:1 expectation fail under incomplete dominance?

A The alleles are lost in the heterozygous offspring entirely

B The two genes are linked on one chromosome pair here

C All of the offspring are identical in phenotype and genotype

D Heterozygotes differ from both homozygotes, giving three classes

> **Answer 598: D**
>
> Correct. Intermediate heterozygotes split the dominant class.

4. Lethal genes

Module 4-10, slide 53 · Lethal genes · Easy

599. What are lethal genes?

A Genes that make the individual grow taller than normal

B Genes that create new alleles in each generation

C Genes whose effect is the death of the individual before maturity

D Genes that are found only on the Y chromosome in all male animals

> **Answer 599: C**
>
> Correct. Lethal genes cause death before maturity.

Module 4-10, slide 53 · Lethal genes · Medium

600. What is a fully dominant lethal allele?

A One that kills only homozygotes while sparing every heterozygote carrier

B One that kills only the female offspring of a cross

C One that has no effect on the survival of the carrier

D One that kills in both the homozygous and heterozygous conditions

> **Answer 600: D**
>
> Correct. A single copy is enough to kill.

Module 4-10, slide 54 · Lethal genes · Medium

601. What is the effect of a recessive lethal gene in the heterozygous condition?

A No effect, but it may show when two carriers mate

B Death of the heterozygote before it can mature

C Sterility of the carrier in both the male and female

D A change of sex in the carrier's own offspring

> **Answer 601: A**
>
> Correct. Carriers survive but can produce affected offspring.

Module 4-10, slide 55 · Lethal genes · Medium

602. What happens to a mutant dominant lethal allele in the population?

A It accumulates steadily over many successive generations

B It is removed in the same generation in which it arose

C It is passed on to every one of the offspring

D It becomes recessive after a single generation

> **Answer 602: B**
>
> Correct. Carriers die before reproducing.

Module 4-10, slide 54 · Lethal genes · Hard

603. Why does a dominant lethal allele rarely pass to the next generation?

A Individuals with it die before they can leave progeny

B It cannot be inherited by any of the offspring

C It changes into a recessive allele in the zygote

D It affects only the gametes and not the rest of the body

> **Answer 603: A**
>
> Correct. Carriers die before reproduction, so the allele is rarely passed on.

Module 4-10, slide 54 · Lethal genes · Hard

604. How can a dominant lethal allele be passed on at all?

A If it is carried only on the Y chromosome of males

B If its effect is delayed until after reproduction

C If it is also recessive in the heterozygote

D If it is linked to two genes

> **Answer 604: B**
>
> Correct. Some dominant lethals have a delayed effect.

Module 4-10, slide 54; general · Lethal genes · Hard

605. Two carriers of a recessive lethal allele mate. What fraction of their zygotes are expected to be homozygous for it?

A One half

B Three quarters

C One quarter

D None

> **Answer 605: C**
>
> Correct. A carrier × carrier cross gives 1/4 homozygotes.

Module 4-10, slide 54 · Lethal genes · Hard

606. A recessive lethal gene is carried in the heterozygous condition. Why is it hard to eliminate from a population?

A It is a dominant allele that kills every carrier

B It mutates back to normal in every single generation

C It affects only males and never any of the females

D Carriers show no effect, so selection does not remove them

> **Answer 606: D**
>
> Correct. Heterozygous carriers survive and reproduce.

Module 4-10, slide 55 · Lethal genes · Devil

607. Why is a dominant lethal mutation lost in the same generation while a recessive lethal can persist?

A The dominant lethal is always linked to a sex chromosome in humans

B The recessive lethal kills only the heterozygous carriers

C A dominant kills every carrier; a recessive hides in survivors

D Both of them persist equally well in the population

> **Answer 607: C**
> Correct. Hidden alleles in carriers persist.

Module 4-10, slide 54; general · Lethal genes · Devil

608. Two carriers of a recessive lethal allele mate and the homozygotes die before birth. What ratio of carriers to normal homozygotes is expected among the survivors?

A 1 carrier : 1 normal

B 3 carriers : 1 normal

C All carriers

D 2 carriers : 1 normal

> **Answer 608: D**
> Correct. Of the surviving three quarters, two thirds are carriers.

5. Allele symbols and dominance hierarchies

Module 4-10, slide 58 · Allele symbols and dominance hierarchies · Easy

609. Which rabbit coat colour allele is dominant to all the others in the series?

A C (full colour)

B cch (chinchilla)

C ch (himalayan)

D c (albino)

> **Answer 609: A**
> Correct. C is dominant to the three mutant alleles.

Module 4-10, slide 59 · Allele symbols and dominance hierarchies · Medium

610. What is the order of dominance of the rabbit coat colour alleles?

A c > ch > cch > C

B C > cch > ch > c

C cch > C > ch > c

D C > ch > cch > c

> **Answer 610: B**
> Correct. The gradation is C > cch > ch > c.

Module 4-10, slide 58 · Allele symbols and dominance hierarchies · Medium

611. What genotype does an albino rabbit have?

A C C

B cch c

C ch c

D cc

> **Answer 611: D**
>
> Correct. Albino is homozygous for the recessive allele.

Module 4-10, slide 58 · Allele symbols and dominance hierarchies · Medium

612. What does the himalayan (ch) rabbit phenotype look like?

A Fully pigmented over the whole of the body

B Mixed coloured with grey and brown patches

C White with black tips on the extremities

D Without any pigment in either the coat or the eyes

> **Answer 612: C**
>
> Correct. Himalayan rabbits are white with dark extremities.

Module 4-10, slide 59; general · Allele symbols and dominance hierarchies · Hard

613. A full-colour rabbit (c c) is mated with an albino rabbit (c c). What phenotypic ratio is expected among the offspring?

A 1 full colour : 1 albino

B 1 chinchilla : 1 himalayan

C 3 himalayan : 1 albino

D 3 chinchilla : 1 albino

> **Answer 613: A**
>
> Correct. The four equally likely offspring genotypes give 1 full colour : 1 albino.

Module 4-10, slide 59; general · Allele symbols and dominance hierarchies · Hard

614. A chinchilla rabbit (cch ch) is mated with a himalayan rabbit (ch c). What phenotypic ratio is expected among the offspring?

A 1 full colour : 1 albino

B 1 chinchilla : 1 himalayan

C 3 himalayan : 1 albino

D 3 chinchilla : 1 albino

> **Answer 614: B**
>
> Correct. The four equally likely offspring genotypes give 1 chinchilla : 1 himalayan.

Module 4-10, slide 59; general · Allele symbols and dominance hierarchies · Hard

615. A himalayan rabbit (ch c) is mated with a himalayan rabbit (ch c). What phenotypic ratio is expected among the offspring?

A 3 himalayan : 1 albino

B 1 full colour : 1 albino

C 1 chinchilla : 1 himalayan

D 3 chinchilla : 1 albino

> **Answer 615: A**
>
> Correct. The four equally likely offspring genotypes give 3 himalayan : 1 albino.

Module 4-10, slide 63 · Allele symbols and dominance hierarchies · Hard

616. In the Drosophila eye colour series, which allele is completely dominant?

A w (white)

B we (eosin)

C wa (apricot)

D W (wild type, red)

> **Answer 616: D**
>
> Correct. The wild-type allele is completely dominant.

Module 4-10, slide 63 · Allele symbols and dominance hierarchies · Hard

617. In the Drosophila eye colour series, which allele is completely recessive to all the others?

A W (wild type)

B w (white)

C wch (cherry)

D wh (honey)

> **Answer 617: B**
>
> Correct. White is recessive to all other alleles in the series.

Module 4-10, slide 63 · Allele symbols and dominance hierarchies · Hard

618. What happens to pigment production as you move down the Drosophila eye colour hierarchy toward w?

A Successively more pigment is produced

B Pigment production stays the same

C Successively less pigment is produced

D Pigment production stops at the first allele

> **Answer 618: C**
>
> Correct. Each allele in the series except w produces some pigment, with less down the series.

Module 4-10, slide 59; general · Allele symbols and dominance hierarchies · Devil

619. A chinchilla rabbit (cch c) is mated with a chinchilla rabbit (cch c). What phenotypic ratio is expected among the offspring?

A 1 full colour : 1 albino

B 1 chinchilla : 1 himalayan

C 3 chinchilla : 1 albino

D 3 himalayan : 1 albino

> **Answer 619: C**
>
> Correct. The four equally likely offspring genotypes give 3 chinchilla : 1 albino.

Module 4-10, slide 59; general · Allele symbols and dominance hierarchies · Devil

620. A full-colour rabbit (c ch) is mated with a himalayan rabbit (ch ch). What phenotypic ratio is expected among the offspring?

A 1 full colour : 1 albino

B 1 chinchilla : 1 himalayan

C 3 himalayan : 1 albino

D 1 full colour : 1 himalayan

> **Answer 620: D**
>
> Correct. The four equally likely offspring genotypes give 1 full colour : 1 himalayan.

Module 4-10, slide 59; general · Allele symbols and dominance hierarchies · Devil

621. A chinchilla rabbit (cch ch) is mated with a chinchilla rabbit (cch ch). What phenotypic ratio is expected among the offspring?

A 3 chinchilla : 1 himalayan

B 1 full colour : 1 albino

C 1 chinchilla : 1 himalayan

D 3 himalayan : 1 albino

> **Answer 621: A**
>
> Correct. The four equally likely offspring genotypes give 3 chinchilla : 1 himalayan.

Module 4-10, slide 56 · Allele symbols and dominance hierarchies · Devil

622. How should symbols be assigned for multiple alleles, according to the lecture?

A A lower case letter for every allele, whatever its place in the dominance series

B Capital for the top allele, lower case for the bottom, superscripts in between

C The same symbol with no superscripts for all of the alleles

D Numbers only, with no letters in any of the allele symbols

> **Answer 622: B**
>
> Correct. Intermediate alleles take lower case letters with suitable superscripts.

6. ABO system: genotypes, antigens and antibodies

Module 4-10, slide 66 · ABO system: genotypes, antigens and antibodies · Easy

623. Which three alleles are common at the ABO locus?

A IA, IB and IO

B A, B and AB

C IA, IB and IAB

D IO, IA and AB

> **Answer 623: A**
>
> Correct. The common ABO alleles are IA, IB and IO.

Module 4-10, slide 67 · ABO system: genotypes, antigens and antibodies · Easy

624. Which ABO allele is recessive?

A IA

B IB

C None of them

D IO

> **Answer 624: D**
>
> Correct. IO is the recessive allele in the ABO system.

Module 4-10, slide 67 · ABO system: genotypes, antigens and antibodies · Medium

625. What antigens are on the red blood cells of an IAIB individual?

A Only A antigen

B Both A and B antigens

C Only B antigen

D No ABO antigens

> **Answer 625: B**
>
> Correct. IA and IB are codominant.

Module 4-10, slide 67 · ABO system: genotypes, antigens and antibodies · Medium

626. What do the red blood cells of an IOIO individual carry?

A Both A and B antigens

B Only A antigen

C No ABO antigens

D Only B antigen

> **Answer 626: C**
>
> Correct. IOIO homozygotes have no ABO antigens.

Module 4-10, slide 72 · ABO system: genotypes, antigens and antibodies · Medium

627. What antibodies are present in the serum of a person of blood group B?

A Anti-A

B Anti-B

C Anti-A and anti-B

D None

> **Answer 627: A**
>
> Correct. Group B has anti-A.

Module 4-10, slide 66 · ABO system: genotypes, antigens and antibodies · Hard

628. How many genotypes and how many phenotypes does the ABO system with three alleles have?

A 3 genotypes and 3 phenotypes

B 6 genotypes and 4 phenotypes

C 4 genotypes and 6 phenotypes

D 6 genotypes and 6 phenotypes

> **Answer 628: B**
>
> Correct. Three alleles give 6 genotypes and the phenotypes are A, B, AB and O.

Module 4-10, slide 68 · ABO system: genotypes, antigens and antibodies · Hard

629. How does the lecture define an antigen?

A A protein that is made by lymphocytes in response to a foreign substance

B A sugar that is found only on the surface of red cells

C A foreign substance that stimulates cells to make specific antibodies

D A chromosome segment that carries the ABO gene locus

> **Answer 629: C**
>
> Correct. An antigen triggers antibody production.

Module 4-10, slide 68 · ABO system: genotypes, antigens and antibodies · Hard

630. How does the lecture define an antibody?

A A sugar found on the surface of the red blood cell

B A foreign substance that stimulates cells to make specific antibodies

C A gene on chromosome 9 that controls the ABO antigens

D An immunoglobulin made by lymphocytes in response to an antigen

> **Answer 630: D**
>
> Correct. Antibodies are immunoglobulin proteins made by lymphocytes.

Module 4-10, slide 69 · ABO system: genotypes, antigens and antibodies · Hard

631. What does the ABO locus control on the surface of red blood cells?

A The number of chromosomes present in the red blood cell

B The overall shape and size of the red blood cell itself

C The type of glycolipid, through the glycosyltransferases

D The colour of the haemoglobin inside the red blood cell

> **Answer 631: C**
>
> Correct. The glycolipids provide antigenic determinants.

Module 4-10, slide 70 · ABO system: genotypes, antigens and antibodies · Hard

632. Why do normal individuals not make antibodies against their own ABO antigens?

A They have no antigens on any of their own red blood cells whatsoever

B They have no lymphocytes that could make antibodies at all

C Their antibodies are destroyed in the liver as they form

D No antibodies are made that react with the individual's own cells

> **Answer 632: D**
>
> Correct. Self-reactive antibodies are not made.

Module 4-10, slide 72 · ABO system: genotypes, antigens and antibodies · Devil

633. Which blood group has no anti-A or anti-B antibodies in its serum?

A AB

B O

C A

D B

> **Answer 633: A**
>
> Correct. Group AB lacks both antibodies.

Module 4-10, slide 72 · ABO system: genotypes, antigens and antibodies · Devil

634. Which blood group carries both anti-A and anti-B antibodies?

A AB

B O

C A

D B

> **Answer 634: B**
>
> Correct. Group O has both antibodies.

Module 4-10, slide 72 · ABO system: genotypes, antigens and antibodies · Devil

635. What are the terminal sugars of blood groups A and B?

A A has galactose; B has galactosamine

B A: galactosamine; B: galactose

C Both: galactose

D Both: galactosamine

> **Answer 635: B**
>
> Correct. A has galactosamine and B has galactose.

Module 4-10, slide 67 · ABO system: genotypes, antigens and antibodies · Devil

636. A person has the genotype IAIO. What are the phenotype and antigen?

A Group O, with no antigen

B Group AB, with both antigens

C Group B, with B antigen

D Group A, with A antigen

> **Answer 636: D**
>
> Correct. IA is expressed and IO is recessive.

7. Blood transfusion and compatibility

Module 4-10, slide 77 · Blood transfusion and compatibility · Easy

637. Which ABO blood group is called the universal donor?

A A

B B

C O

D AB

> **Answer 637: C**
>
> Correct. Group O cells have no A or B antigens.

Module 4-10, slide 72 · Blood transfusion and compatibility · Medium

638. Which red cell groups can a person of blood group A accept?

A A or O

B B or O

C A or B

D AB only

> **Answer 638: A**
>
> Correct. Group A can receive A or O.

Module 4-10, slide 72 · Blood transfusion and compatibility · Medium

639. Which red cell groups can a person of blood group B accept?

A A or O

B B or O

C A or B

D AB only

> **Answer 639: B**
>
> Correct. Group B can receive B or O.

Module 4-10, slide 72 · Blood transfusion and compatibility · Medium

640. Which red cell groups can a person of blood group AB accept?

A A, B, AB and O

B AB only

C O only

D A and B only

> **Answer 640: A**
>
> Correct. Group AB has no antibodies.

Module 4-10, slide 77 · Blood transfusion and compatibility · Hard

641. Why can type O blood be used for any recipient only if introduced slowly?

A So that the antigens on the donor red cells are fully destroyed

B So that the recipient can make enough new blood in time

C So that anti-A and anti-B in the donor serum are diluted

D So that the donor blood can cool to body temperature

> **Answer 641: C**
>
> Correct. Slow introduction dilutes the donor's antibodies.

Module 4-10, slide 72 · Blood transfusion and compatibility · Hard

642. Which red cell group can a person of blood group O accept?

A A or O

B B or O

C A, B and O

D O only

> **Answer 642: D**
>
> Correct. Group O has anti-A and anti-B.

Module 4-10, slide 73 · Blood transfusion and compatibility · Hard

643. What happens when blood of types A and B are mixed?

A The cells burst at once, releasing their haemoglobin

B Nothing happens at all, because the two blood groups are compatible

C The red cells fuse together to make new AB cells

D Antibodies in each serum attack the other's cells, causing clumping

> **Answer 643: D**
>
> Correct. Anti-A and anti-B cause clumping.

Module 4-10, slide 76 · Blood transfusion and compatibility · Hard

644. Why can group AB persons accept blood of any ABO group?

A They have no anti-A or anti-B antibodies in their serum

B They have all of the possible antibodies in their serum plasma

C They have no antigens on any of their red blood cells

D They have no red cells in their circulating blood

> **Answer 644: A**
>
> Correct. AB serum lacks both antibodies.

Module 4-10, slide 73 · Blood transfusion and compatibility · Devil

645. Why is it harmful to give group B blood to a group A recipient?

A The donor's anti-A antibodies would attack nothing in the recipient's blood

B The recipient has no antibodies in the serum at all

C The recipient's anti-B antibodies agglutinate the donor's B cells

D The donor's cells become group O after the transfusion

> **Answer 645: C**
>
> Correct. Anti-B in group A serum attacks B cells.

Module 4-10, slide 77 · Blood transfusion and compatibility · Devil

646. Why is group AB not the universal donor?

A It has no red cells that could safely be transfused

B Its cells carry A and B antigens that many recipients would attack

C It carries both the anti-A and the anti-B antibodies in its serum plasma

D It is simply the rarest blood group in every population

> **Answer 646: B**
>
> Correct. A and B antigens can be targeted.

8. ABO inheritance and paternity

Module 4-10, slide 66 · ABO inheritance and paternity · Easy

647. Which genotypes can a person of blood group A have?

A IBIB or IBIO

B IAIB only

C IAIA or IAIO

D IOIO only

> **Answer 647: C**
>
> Correct. A is IAIA or IAIO.

Module 4-10, slide 79 · ABO inheritance and paternity · Medium

648. A parent of group AB (heterozygous where possible) mates with a parent of group O. Which phenotypes can appear among their children?

A A and O

B B and O

C A, B, AB and O

D A and B only

> **Answer 648: D**
>
> Correct. The possible children are A and B only.

Module 4-10, slide 79 · ABO inheritance and paternity · Medium

649. A parent of group A (heterozygous where possible) mates with a parent of group O. Which phenotypes can appear among their children?

A A and O

B B and O

C A, B, AB and O

D A, B and AB

> **Answer 649: A**
>
> Correct. The possible children are A and O.

Module 4-10, slide 79 · ABO inheritance and paternity · Medium

650. A parent of group B (heterozygous where possible) mates with a parent of group B. Which phenotypes can appear among their children?

A A and O

B B and O

C A, B, AB and O

D A, B and AB

> **Answer 650: B**
>
> Correct. The possible children are B and O.

Module 4-10, slide 79 · ABO inheritance and paternity · Medium

651. A parent of group O (heterozygous where possible) mates with a parent of group O. Which phenotypes can appear among their children?

A A and O

B O only

C B and O

D A, B, AB and O

> **Answer 651: B**
>
> Correct. The possible children are O only.

Module 4-10, slide 81 · ABO inheritance and paternity · Hard

652. Which mating can produce children of all four ABO phenotypes?

A Two heterozygous parents, one group A and one group B

B Two parents who are both of blood group AB

C One group O parent and one group AB parent together

D Two parents who are both heterozygous and both of blood group A

> **Answer 652: A**
>
> Correct. IAIO × IBIO can give A, B, AB and O.

Module 4-10, slide 79 · ABO inheritance and paternity · Hard

653. What fraction of the children of IAIO × IBIO are group AB?

A One half

B Three quarters

C One quarter

D None

> **Answer 653: C**
>
> Correct. IAIB is one of four equally likely genotypes.

Module 4-10, slide 83 · ABO inheritance and paternity · Hard

654. A woman of group A has a child of group O. The alleged father is group AB. Can ABO typing exclude him?

A No, because group A mothers can have group O children with any man

B No, because ABO typing cannot exclude anyone

C Yes, because AB men cannot have children

D Yes, because an AB man has no IO allele to give an O child

> **Answer 654: D**
>
> Correct. An O child needs IO from each parent.

Module 4-10, slide 80 · ABO inheritance and paternity · Hard

655. A woman of group B has a child of group AB. The alleged father is group O. Can ABO typing exclude him?

A No, because a group B mother can also supply the IA allele to the child

B Yes, because AB children can never have group B mothers

C Yes: an AB child needs IA from the father, and an O man lacks it

D No, because O men are universal fathers of every child

> **Answer 655: C**
> Correct. The IA allele must come from the father.

Module 4-10, slide 80 · ABO inheritance and paternity · Hard

656. What can blood typing tell us about disputed parentage?

A It can exclude a man as the father but cannot prove he is the father

B It can always prove exactly which man is the real father of a given child

C It can never help in any case of disputed parentage

D It can tell only the age of the mother and the child

> **Answer 656: A**
> Correct. A matching type fits many men.

Module 4-10, slide 81 · ABO inheritance and paternity · Devil

657. Two group A parents have a group O child. What are the genotypes of the parents?

A Both IAIA

B One IAIA and one IAIO

C One IAIO and one IOIO

D Both IAIO

> **Answer 657: D**
> Correct. Each parent must give an IO allele.

Module 4-10, slide 78 · ABO inheritance and paternity · Devil

658. Two group O parents have a child. Which blood group can the child have?

A A

B Only O

C B

D AB

> **Answer 658: B**
> Correct. Both parents give IO.

659. A group A parent and a group B parent have a group O child. What are their genotypes?

A IAIA and IBIB

B IAIO and IBIO

C IAIO and IBIB

D IAIA and IBIO

> **Answer 659: B**
>
> Correct. Both parents must carry IO.

Module 9: Pedigree analysis — 51 questions

1. Pedigree conventions and symbols

Module 4-10, slide 88 · Pedigree conventions and symbols · Easy

660. What is a pedigree?

A A diagram of the phases of the cell cycle in a single dividing cell

B A chart listing only the blood groups of a family

C A map of the positions of genes on the chromosomes

D A diagram of family relationships and the passing of a trait

> **Answer 660: D**
>
> Correct. A pedigree traces a trait through family generations.

Module 4-10, slide 91 · Pedigree conventions and symbols · Easy

661. In a pedigree, what do circles and squares represent?

A Circles are females and squares are males

B Circles are males and squares are females

C Both of the symbols represent female individuals

D Both of the symbols represent individuals of unknown sex

> **Answer 661: A**
>
> Correct. Circles are females and squares are males.

Module 4-10, slide 91 · Pedigree conventions and symbols · Medium

662. Which symbol is used for an individual whose sex is unknown?

A A triangle

B A filled circle

C A diamond

D A double line

> **Answer 662: C**
>
> Correct. A diamond marks unknown sex.

Module 4-10, slide 92 · Pedigree conventions and symbols · Medium

663. How are the generations of a pedigree labelled?

A With Roman numerals, one row per generation

B With Arabic numerals, one column per generation

C With letters of the alphabet along a single row

D With colours only, using one colour per generation

> **Answer 663: A**
>
> Correct. Each generation is on its own row with a Roman numeral.

Module 4-10, slide 91 · Pedigree conventions and symbols · Medium

664. How are siblings labelled and arranged in a pedigree?

A From right to left by age, using capital letters for each sibling

B From left to right by birth order, with Arabic numerals

C In random order, using Roman numerals for each sibling

D In a single vertical line, with no labels at all

> **Answer 664: B**
>
> Correct. Siblings are numbered 1, 2, 3 and so on, left to right.

Module 4-10, slide 93 · Pedigree conventions and symbols · Hard

665. What is the individual whose phenotype first attracted attention called?

A The founder, the first known ancestor in the family line

B The twin sibling of the affected family member

C The proband (propositus if male, proposita if female)

D The carrier who passes the allele to the child

> **Answer 665: C**
>
> Correct. An arrow points to the proband.

Module 4-10, slide 92 · Pedigree conventions and symbols · Hard

666. How are twins shown in a pedigree?

A By two squares joined together by a short horizontal line

B By a double circle drawn around the one symbol

C By shading both of the symbols with a dark colour

D By connected diagonal lines from the parents' line

> **Answer 666: D**
>
> Correct. Twins are indicated by connected diagonal lines.

Module 4-10, slide 91 · Pedigree conventions and symbols · Hard

667. How are the two parents joined in a pedigree?

A By a diagonal line, with a vertical line leading down to the offspring

B By a dotted circle drawn around the two parents together

C They are not joined by any line in the diagram at all

D By a horizontal line, with a vertical line leading to their offspring

> **Answer 667: D**
>
> Correct. A horizontal line joins the parents.

Module 4-10, slide 92 · Pedigree conventions and symbols · Devil

668. What do the different shades or colours added to pedigree symbols represent?

A Different generations

B Different sexes

C Different phenotypes

D Different ages

> **Answer 668: C**
>
> Correct. Shading marks affected and unaffected phenotypes.

Module 4-10, slide 89 · Pedigree conventions and symbols · Devil

669. Why is pedigree analysis used in human genetics?

A Humans have no genes that could be traced in families

B Experimental matings are not possible in humans

C Humans have only one generation that can be studied

D Humans cannot inherit traits from either of their parents

> **Answer 669: B**
>
> Correct. Pedigrees substitute for breeding studies.

2. Patterns of inheritance in pedigrees

Module 4-10, slide 87 · Patterns of inheritance in pedigrees · Easy

670. Which of these is an example of an autosomal dominant disease in the lecture's table?

A Huntington's disease

B Cystic fibrosis

C Albinism

D Sickle cell disease

> **Answer 670: A**
>
> Correct. Huntington's disease is autosomal dominant.

Module 4-10, slide 87 · Patterns of inheritance in pedigrees · Medium

671. Which pattern is typical of an autosomal recessive disease?

A It never skips a generation in the family tree of affected people

B All of the daughters of an affected father are always affected

C It can skip generations, and unaffected parents can have affected children

D It never occurs in females and appears only in the males

> **Answer 671: C**
>
> Correct. Carriers hide the trait.

Module 4-10, slide 87 · Patterns of inheritance in pedigrees · Medium

672. Which of these is an example of an autosomal recessive disease in the lecture's table?

A Cystic fibrosis

B Huntington's disease

C Marfan syndrome

D Achondroplasia

> **Answer 672: A**
>
> Correct. Cystic fibrosis is autosomal recessive.

Module 4-10, slide 87 · Patterns of inheritance in pedigrees · Medium

673. Which of these is an example of an X-linked dominant disease in the lecture's table?

A Sickle cell disease

B Cystic fibrosis

C Albinism

D Rett syndrome

> **Answer 673: D**
>
> Correct. Rett syndrome is listed under X-linked dominant disease.

Module 4-10, slide 87 · Patterns of inheritance in pedigrees · Hard

674. What happens to daughters of an affected father in X-linked dominant inheritance?

A None of the daughters will be affected

B All of the daughters will be affected

C Half of the daughters will be affected

D Only the sons will be affected

> **Answer 674: B**
>
> Correct. The father passes his X to every daughter.

Module 4-10, slide 87 · Patterns of inheritance in pedigrees · Hard

675. Which statement is true of X-linked dominant disease?

A It always passes from father to son

B The disease regularly skips whole generations

C The disease occurs only in male individuals

D The disease never passes from father to son

> **Answer 675: D**
>
> Correct. Sons receive the Y from their father.

Module 4-10, slide 87 · Patterns of inheritance in pedigrees · Hard

676. Why can unaffected parents have an affected child in an autosomal recessive disease?

A The child inherits the disease from the environment alone, not genes

B The parents are both homozygous dominant at that gene locus

C Both parents can be carriers who each pass on the recessive allele

D The disease is always caused by a brand new mutation in the child

> **Answer 676: C**
>
> Correct. Carrier parents can have an aa child.

Module 4-10, slide 87 · Patterns of inheritance in pedigrees · Hard

677. Why does an autosomal dominant disease not skip generations?

A The allele is carried only on the Y chromosome of male individuals

B Any individual carrying the dominant allele shows the disease

C Carriers stay hidden and unaffected in every generation

D Only the mother ever passes it on to her own children

> **Answer 677: B**
>
> Correct. A single dominant allele is expressed.

Module 4-10, slide 87 · Patterns of inheritance in pedigrees · Hard

678. In which pattern can males not pass the disease to their sons?

A X-linked inheritance

B Autosomal dominant inheritance

C Autosomal recessive inheritance

D Codominant inheritance

> **Answer 678: A**
>
> Correct. A father gives his Y to sons.

Module 4-10, slide 87 · Patterns of inheritance in pedigrees · Devil

679. A trait passes from an affected father to all of his daughters and to none of his sons. Which pattern fits?

A X-linked dominant

B Autosomal recessive

C Y-linked

D Autosomal dominant

> **Answer 679: A**
>
> Correct. The father's X goes to all daughters and his Y to sons.

Module 4-10, slide 87 · Patterns of inheritance in pedigrees · Devil

680. Two unaffected parents have an affected child. Which two patterns are consistent with this?

A Both autosomal dominant and X-linked dominant

B Only the X-linked dominant pattern of inheritance

C Only the autosomal dominant pattern of inheritance

D Autosomal recessive and X-linked recessive

> **Answer 680: D**
>
> Correct. Carrier parents can have affected children.

Module 4-10, slide 87 · Patterns of inheritance in pedigrees · Devil

681. Which feature most strongly suggests an autosomal recessive pattern in a pedigree?

A Every single generation has some affected individuals in the family

B All of the daughters of affected men are also affected

C Affected individuals appear to be children of unaffected parents

D No daughters are ever affected in any of the families

> **Answer 681: C**
>
> Correct. Unaffected carriers can have affected children.

3. Analyzing the albinism pedigree

Module 4-10, slide 95 · Analyzing the albinism pedigree · Easy

682. How is albinism inherited, according to the lecture's pedigree?

A As a dominant trait

B As a recessive trait

C As an X-linked dominant trait

D As a Y-linked trait

> **Answer 682: B**
>
> Correct. The pedigree shows a recessive pattern.

Module 4-10, slide 96 · Analyzing the albinism pedigree · Medium

683. Parents I-2 and I-4 are affected, but none of their offspring is affected. What does this suggest about parents I-1 and I-3?

A They were probably homozygous normal

B They were probably heterozygous carriers

C They were probably affected like their partners

D They were carriers of two recessive alleles

> **Answer 683: A**
>
> Correct. If they were heterozygous, half the offspring would be affected.

Module 4-10, slide 98 · Analyzing the albinism pedigree · Medium

684. What is characteristic of a recessive trait in the second generation of this pedigree?

A Half are affected

B It is unaffected

C All are affected

D Only males are affected

> **Answer 684: B**
>
> Correct. An unaffected second generation is characteristic of a recessive trait.

Module 4-10, slide 98 · Analyzing the albinism pedigree · Hard

685. If albinism were dominant, what would be expected among the second-generation offspring of the affected I-2 and I-4?

A None would be affected

B All would be affected

C Only males would be affected

D About half would be affected

> **Answer 685: D**
>
> Correct. A dominant allele in the affected parent would be passed to half.

Module 4-10, slide 99 · Analyzing the albinism pedigree · Hard

686. Parents II-3 and II-4 are heterozygous. About what fraction of their offspring should be affected?

A One half

B Three quarters

C One quarter

D None

> **Answer 686: C**
>
> Correct. Aa × Aa gives 1/4 aa.

Module 4-10, slide 99 · Analyzing the albinism pedigree · Hard

687. II-3 and II-4 are both heterozygous, and two of their six offspring are affected. How does this compare with the expected fraction?

A It is exactly 1/2, which is exactly double the expected value of 1/4

B It is near the 1/4 expected, since two of six is about one third

C It is zero, so no child is expected to be affected

D It disproves the whole recessive pattern of inheritance

> **Answer 687: B**
>
> Correct. Two of six is close to the expected quarter given a small sample.

Module 4-10, slide 100 · Analyzing the albinism pedigree · Hard

688. II-7 is heterozygous and II-8 is homozygous normal. What is expected among their offspring?

A Half will be affected

B All will be affected

C One quarter will be affected

D None will be affected

> **Answer 688: D**
>
> Correct. A homozygous normal parent gives only A alleles.

Module 4-10, slide 101 · Analyzing the albinism pedigree · Devil

689. Why can a normal-looking child of two carriers not be given a definite genotype?

A The child has no genes at all for the trait in question

B All such children are definitely carriers, so no probabilities are needed

C Aa and AA children look identical, so only probabilities can be given

D All such children are definitely homozygous recessive

> **Answer 689: C**
>
> Correct. Normal phenotype does not distinguish AA from Aa.

Module 4-10, slide 96 · Analyzing the albinism pedigree · Devil

690. In the albinism pedigree, why can individuals I-1 and I-3 be assigned the genotype AA only as an assumption?

A Normal phenotype fits Aa, but no affected children suggest AA

B Because they are affected by the trait themselves in the pedigree

C Because they carry two recessive alleles for the trait

D Because they are the proband of the whole family pedigree

> **Answer 690: A**
>
> Correct. Phenotype alone cannot prove AA, but the evidence points to it.

4. Inferring genotypes and the marrying-in assumption

Module 4-10, slide 106 · Inferring genotypes and the marrying-in assumption · Easy

691. What is assumed about individuals who marry into the family unless there is evidence otherwise?

A They are all heterozygous carriers of the recessive gene of the family

B They are homozygous dominant and carry no recessive gene

C They are all affected by the trait in the same way

D They are all closely related to the family they marry into

> **Answer 691: B**
>
> Correct. This is the marrying-in assumption.

Module 4-10, slide 107 · Inferring genotypes and the marrying-in assumption · Medium

692. A woman (II-3) shows the recessive trait. What is her genotype?

A aa

B AA

C Aa

D aA only

> **Answer 692: A**
>
> Correct. A recessive trait appears only in the homozygous recessive.

Module 4-10, slide 107 · Inferring genotypes and the marrying-in assumption · Hard

693. II-3 is aa and her parents I-1 and I-2 are unaffected. What are their genotypes?

A Both AA

B One AA and one aa

C Both heterozygous, Aa

D Both aa

> **Answer 693: C**
>
> Correct. Each parent gave an a allele but is unaffected.

Module 4-10, slide 109 · Inferring genotypes and the marrying-in assumption · Hard

694. Siblings II-1 and II-6 are unaffected children of two heterozygous parents. What can be said about their genotypes?

A Each is aa, since both of the parents are known carriers of the gene

B Each is definitely AA, since the parents are normal

C Each is definitely Aa, since the parents are carriers

D Each is AA or Aa, and the carrier probability must be estimated

> **Answer 694: D**
>
> Correct. They cannot be aa, but AA and Aa cannot be told apart.

Module 4-10, slide 106 · Inferring genotypes and the marrying-in assumption · Devil

695. Why does the marrying-in assumption simplify pedigree probability?

A Spouses are treated as AA, so only the family carries the allele

B It makes every unrelated spouse a carrier of the allele

C It removes the need for any calculation of the probabilities at all

D It makes the trait dominant in every family generation

> **Answer 695: A**
>
> Correct. Spouses are taken as non-carriers unless shown otherwise.

Module 4-10, slide 103 · Inferring genotypes and the marrying-in assumption · Devil

696. If no expression has occurred in the history of a family, what is used as the basis of probability?

A The age of the proband when the trait was first seen by a doctor

B An estimate of the gene's frequency in the general population

C The number of children born to the affected couple

D The month of birth of the proband and the siblings

> **Answer 696: B**
>
> Correct. The population frequency of the allele is used.

5. The three steps and the product rule

Module 4-10, slide 105 · The three steps and the product rule · Medium

697. How many basic steps does the lecture list for pedigree probability?

A Two

B Four

C Three

D Five

> **Answer 697: C**
>
> Correct. There are three basic steps.

Module 4-10, slide 105 · The three steps and the product rule · Medium

698. What do you do with the separate probabilities in pedigree analysis?

A Add them together to get the chance a child is affected

B Subtract them one from the other to get the chance a child is affected

C Ignore them and rely on the sex of the child instead

D Multiply them to get the chance a child expresses the trait

> **Answer 698: D**
>
> Correct. The product of the probabilities is the chance.

Module 4-10, slide 105 · The three steps and the product rule · Hard

699. Each parent is a carrier (Aa) of a recessive trait. What is the chance a child will express it?

A 1/2

B 3/4

C 1/8

D 1/4

> **Answer 699: D**
>
> Correct. $1 \times 1 \times 1/4 = 1/4$.

Module 4-10, slide 110 · The three steps and the product rule · Hard

700. A parent has a 2/3 chance of being a carrier and the other parent is a known carrier. What is the chance a child is affected?

A 1/4
B 1/3
C 1/6
D 1/12

> **Answer 700: C**
> Correct. 2/3 × 1 × 1/4 = 1/6.

Module 4-10, slide 110; general · The three steps and the product rule · Hard

701. Both parents each have a 2/3 chance of being carriers of a recessive allele. What is the chance their child is affected?

A 1/9
B 1/4
C 1/6
D 4/9

> **Answer 701: A**
> Correct. 2/3 × 2/3 × 1/4 = 1/9.

Module 4-10, slide 105; general · The three steps and the product rule · Devil

702. Two carriers (Aa × Aa) have three children. What is the chance that all three are unaffected?

A 1/64
B 27/64
C 3/4
D 9/16

> **Answer 702: B**
> Correct. Each child is unaffected with probability 3/4, so $(3/4)^3 = 27/64$.

Module 4-10, slide 105; general · The three steps and the product rule · Devil

703. Two carriers (Aa × Aa) have two children. What is the chance that both are affected?

A 1/4
B 1/8
C 1/2
D 1/16

> **Answer 703: D**
> Correct. Each child is affected with probability 1/4, so $(1/4)^2 = 1/16$.

Module 4-10, slide 105 · The three steps and the product rule · Devil

704. Two carriers have an affected first child. What is the chance their second child is also affected?

A 1/4
B 1/16
C 1/2
D 0

> **Answer 704: A**
> Correct. Each child is an independent event with chance 1/4.

6. Solved problem: free earlobes

Module 4-10, slide 110 · Solved problem: free earlobes · Medium

705. Two heterozygous (Aa) parents have a child with free earlobes. What is the probability that this child is a carrier (Aa)?

A 1/2
B 2/3
C 1/3
D 3/4

> **Answer 705: B**
> Correct. The child is AA or Aa in ratio 1:2, so Aa is 2/3.

Module 4-10, slide 110 · Solved problem: free earlobes · Medium

706. Two Aa parents have a child with free earlobes. What is the probability that this child is AA?

A 2/3
B 1/4
C 1/3
D 3/4

> **Answer 706: C**
> Correct. Among unaffected children, AA is 1/3.

Module 4-10, slide 111 · Solved problem: free earlobes · Hard

707. An Aa (probability 2/3) individual marries a homozygous AA individual. What is the probability that a child is a carrier?

A 1/2
B 2/3
C 1/6
D 1/3

Answer 707: D

Correct. 2/3 × 1/2 = 1/3.

Module 4-10, slide 111 · Solved problem: free earlobes · Hard

708. A woman with the recessive trait (aa) has children with a homozygous normal man (AA). What is the probability that each child is a carrier?

A 1/2

B 1 (certain)

C 1/4

D 0

Answer 708: B

Correct. Every child receives an a from her and an A from him.

Module 4-10, slide 111 · Solved problem: free earlobes · Hard

709. Why is the probability 2/3 × 1/2 = 1/3 used for a grandchild being a carrier?

A The parent is affected with probability 1/3 and passes the trait on with 1/2

B The child inherits both of its two alleles from the one carrier parent

C The parent is a carrier with probability 2/3, then passes it on with 1/2

D The marriage is between two known carriers of the recessive allele

Answer 709: C

Correct. The two steps multiply.

Module 4-10, slide 110 · Solved problem: free earlobes · Devil

710. If one Aa carrier parent mates with an AA parent, what fraction of the children are expected to be carriers?

A One half

B All of them

C None of them

D One quarter

Answer 710: A

Correct. Aa × AA gives half Aa and half AA.

Module 10: Practice Paper — Modules 1–3 — 100 questions

1. Full paper

Practice Paper · Full paper · Easy

711. Which scientist does the lecture credit with proposing pangenesis?

A Jean-Baptiste Lamarck

B Charles Darwin

C August Weismann

D Gregor Mendel

Answer 711: B key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Easy

712. The "homunculus" belongs to which early theory of heredity?

A Epigenesis

B Preformation

C Pangenesis

D Germplasm theory

Answer 712: B key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Medium

713. A weightlifter's children inherit the large muscles he built through training. Which theory would predict this?

A Epigenesis, because tissues form gradually in the embryo

B Preformation, because the body is already formed in the gamete

C Lamarckism, because acquired characteristics can be passed on

D Germplasm theory, because body changes reach the gametes

Answer 713: C key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Medium

714. According to pangenesis, how did information about body parts reach the next generation?

A A miniature copy of each organ was stored in the gamete from the start

B Gemmules formed in each body part travelled in the blood to the sperm and eggs

C Acquired habits changed the semen directly during mating

D The zygote copied the parents' appearance by gradual differentiation

Answer 714: B key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Medium

715. What best distinguishes epigenesis from preformation?

A In epigenesis the gamete holds a miniature body, while in preformation the body forms by gradual change

B Epigenesis claims acquired traits are inherited, while preformation denies that traits can be passed on

C Epigenesis requires gemmules in the blood, while preformation requires no transport of material

D In epigenesis tissues form gradually by differentiation; in preformation the body just grows

Answer 715: D key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Medium

716. Which pairing of scientist and idea is correct?

A Jan Swammerdam: epigenesis, the gradual formation of the body

B August Weismann: the germplasm theory, a challenge to pangenesis

C Kasper Wolff: pangenesis, the gemmules carried in the blood

D Jean-Baptiste Lamarck: preformation, the miniature body in the gamete

Answer 716: B key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Medium

717. Spermatists and ovists were both preformationists. What did they disagree about?

A Whether development involves any growth at all

B Whether acquired traits are passed on to offspring

C Whether the miniature individual was in the sperm or in the egg

D Whether gemmules travel in the blood to the gonads

Answer 717: C key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Hard

718. Assertion: Observations of chick embryos supported epigenesis over preformation. Reason: The chick shows a gradual change from the egg to the foetus and finally to the adult body, not the enlargement of a ready-made miniature.

A Both the assertion and the reason are true, and the reason is the correct explanation of the assertion.

B Both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.

C The assertion is true, but the reason is false.

D The assertion is false, but the reason is true.

Answer 718: A key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Hard

719. Which of the following statements about early theories of heredity are correct?
1. Pangenesis proposed that gemmules from each body part reach the gametes.
2. Preformation held that a miniature individual already exists in the gamete.
3. Epigenesis held that the gametes contain a small version of the body.

A 1, 2 and 3

B 2 and 3 only

C 1 and 2 only

D 1 and 3 only

Answer 719: C key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Hard

720. Match each statement to the theory it illustrates.
(i) An acquired scar is passed on to offspring.
(ii) A tiny man is already present in the sperm.
(iii) Gemmules from every organ gather in the gonads.

A (i) Pangenesis; (ii) preformation; (iii) Lamarckism

B (i) Lamarckism; (ii) epigenesis; (iii) pangenesis

C (i) Preformation; (ii) Lamarckism; (iii) epigenesis

D (i) Lamarckism; (ii) preformation; (iii) pangenesis

Answer 720: D key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Devil

721. A student argues: "Epigenesis beat preformation, so the zygote carries no hereditary information at all." Which response is most accurate?

A Right: epigenesis says gametes contain no information, so development depends on the environment alone

B Wrong: the zygote does contain a miniature organism, because preformation was shown to be correct

C Right: only the parents' acquired characteristics direct development, as Lamarckism taught

D Wrong: the body is not preformed, but the zygote carries DNA information that, with the environment, directs development

Answer 721: D key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Easy

722. What is the scientific name of the plant Mendel used?

A Zea mays

B Oryza sativa

C Pisum sativum

D Arabidopsis thaliana

> **Answer 722: C** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Easy

723. How does the lecture describe Mendel?

A A Dutch microscopist who studied sperm cells in Delft

B An Austrian monk at St Thomas monastery in Brünn

C An English naturalist who travelled on a long research voyage

D A French army officer who bred farm animals for a living

> **Answer 723: B** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Easy

724. A pea plant has the genotype Dd. What is it called?

A Homozygous dominant

B Heterozygous

C Homozygous recessive

D Hemizygous

> **Answer 724: B** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Easy

725. The position of a gene on a chromosome is called its:

A Allele

B Genotype

C Locus

D Phenotype

> **Answer 725: C** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Medium

726. Which statement best describes an allele?

A The section of chromosome where a gene is located on the chromosome

B The visible expression of an inherited trait in an organism

C A change in the number of chromosomes present in a cell

D An alternative form of a gene, carried one per homologous chromosome

> **Answer 726: D** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Medium

727. Why were pea flowers convenient for Mendel's work with self-fertilization?

A They have male and female parts on separate plants entirely

B They cannot be fertilized by pollen from any other plant

C They are perfect flowers, so they can self-fertilize

D They produce seeds without any fertilization taking place

> **Answer 727: C** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Medium

728. Which trait would be least suitable for Mendel's method of studying simple on-or-off traits?

A Seed weight, which is controlled by many genes

B Flower colour, which is purple or white

C Seed texture, which is round or wrinkled

D Plant height, which is tall or dwarf

> **Answer 728: A** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Medium

729. Besides studying one character at a time, what made Mendel's approach distinctive?

A He used microscopes to look for gemmules in the pollen

B He counted progeny of each kind to test the proportions

C He judged the overall resemblance of whole plants to parents

D He relied on natural pollination without controlled crosses

> **Answer 729: B** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

730. Mendel removed the anthers from the "test" flowers before crossing. What would happen if he had not?

A The flowers would produce no seeds at all after the cross

B All offspring would automatically be tall, whatever the pollen

C The pollen from the other parent could not fertilize the ovules

D Some seeds would come from self-pollination, mixing the cross

> **Answer 730: D** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

731. Assertion: A recessive allele can be present in a plant that looks like the dominant type. Reason: In the heterozygote the dominant allele determines the visible trait.

A Both the assertion and the reason are true, and the reason is the correct explanation of the assertion.

B Both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.

C The assertion is true, but the reason is false.

D The assertion is false, but the reason is true.

> **Answer 731: A** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

732. Which statements about genotype and phenotype are correct?
1. A phenotype is any measurable characteristic of an organism.
2. A genotype is the set of alleles an individual possesses.
3. A phenotype is fixed by the genotype alone, whatever the environment.

A 1, 2 and 3

B 1 and 2 only

C 2 and 3 only

D 1 and 3 only

> **Answer 732: B** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Medium

733. In Mendel's tall × dwarf experiment the F2 contained 787 tall and 277 dwarf plants. The ratio is closest to:

A 1:1

B 2:1

C 3:1

D 4:1

Answer 733: C key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Medium

734. Why are all the F1 plants of a tall × dwarf cross tall?

A The dwarf allele is lost during fertilization of the zygote

B Each F1 plant receives two tall alleles from its parents

C Dwarfness is controlled by many genes acting together

D Each F1 plant is Dd, and the tall allele is dominant

Answer 734: D key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Devil

735. A farmer crosses two pea lines that differ in seed weight. The F2 plants show a smooth range of weights, not distinct classes. What is the best explanation?

A Seed weight is a quantitative trait controlled by many genes

B The law of segregation does not apply to pea plants at all

C The F1 plants must have been tall rather than dwarf

D Dominance is complete, so only two classes should appear

Answer 735: A key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Easy

736. What did Mendel call the rule that the two factors for a trait separate into different gametes?

A The principle of independent assortment

B The principle (law) of segregation

C The principle of dominance only

D The principle of blending inheritance

Answer 736: B key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Medium

737. What does "purity of gametes" mean in Mendel's principle of segregation?

A Each gamete carries one allele of each pair, not a mixture

B Each gamete carries both alleles of every pair together

C Gametes are completely free from every kind of mutation

D Gametes come only from parents that are homozygous

Answer 737: A key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Medium

738. A heterozygous Dd plant produces which gametes?

A All Dd

B Half D and half d

C All D

D Three D for every d

> **Answer 738: B** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

739. Why can the separation of alleles be detected only in a heterozygous parent?

A Only Dd plants undergo meiosis to produce gametes

B Only Dd plants carry a dominant allele for the trait

C Only Dd makes two kinds of gametes; DD and dd each make one

D DD and dd plants cannot form functional gametes at all

> **Answer 739: C** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

740. Two Dd plants are crossed. Which genotype ratio is expected in the offspring?

A 3 DD : 1 dd

B 1 DD : 1 Dd : 1 dd

C 1 Dd : 1 dd

D 1 DD : 2 Dd : 1 dd

> **Answer 740: D** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

741. Of 400 offspring from a Dd × Dd cross, how many are expected to be dwarf (dd) and how many heterozygous (Dd)?

A 100 dwarf and 200 heterozygous

B 100 dwarf and 100 heterozygous

C 200 dwarf and 100 heterozygous

D 300 dwarf and 100 heterozygous

> **Answer 741: A** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Devil

742. A tall F2 plant from a Dd × Dd cross is chosen at random. What is the probability that it is heterozygous?

A 1/2
B 1/3
C 2/3
D 3/4

> **Answer 742: C** key only
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

743. Assertion: In a Dd × Dd cross the dwarf phenotype reappears in the F2.
Reason: Each Dd parent makes d gametes, so two d gametes can meet at fertilization.

A Both the assertion and the reason are true, and the reason is the correct explanation of the assertion.
B Both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.
C The assertion is true, but the reason is false.
D The assertion is false, but the reason is true.

> **Answer 743: A** key only
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

744. Which statements about the F1 (Dd) plants of a tall × dwarf cross are correct?
1. The F1 is hybrid for only one character.
2. Its tall appearance is due to a dominant allele.
3. It will breed true for tallness when self-fertilized.

A 1 and 2 only
B 1, 2 and 3
C 2 and 3 only
D 1 and 3 only

> **Answer 744: A** key only
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Medium

745. A cross of an organism of unknown genotype to a homozygous recessive organism is called a:

A Backcross
B Testcross
C Reciprocal cross
D Monohybrid cross

Answer 745: B key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Hard

746. What is the key difference between a testcross and a backcross?

A A backcross always uses a homozygous recessive parent, a testcross does not

B A testcross uses only the F1, while a backcross uses unrelated plants

C They are identical in every case, with no difference between them

D A testcross always uses a homozygous recessive parent, a backcross need not

Answer 746: D key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Medium

747. An F1 (Dd) plant is crossed back to the dwarf (dd) variety. What offspring ratio is expected?

A 3 tall : 1 dwarf

B 1 tall : 1 dwarf

C All tall

D All dwarf

Answer 747: B key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Devil

748. Assertion: Crossing an F1 (Dd) plant back to its dwarf (dd) parent is both a backcross and a testcross.
Reason: The dwarf parent is homozygous recessive and is one of the F1 plant's parents.

A Both the assertion and the reason are true, and the reason is the correct explanation of the assertion.

B Both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.

C The assertion is true, but the reason is false.

D The assertion is false, but the reason is true.

Answer 748: A key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Devil

749. Classify each cross.
(i) A tall plant of unknown genotype, unrelated to the dwarf plant, × a dwarf (dd) plant.
(ii) An F1 (Dd) plant × its tall (DD) parent.
(iii) An F1 (Dd) plant × its dwarf (dd) parent.

A (i) backcross only; (ii) testcross only; (iii) both a testcross and a backcross
B (i) testcross only; (ii) testcross only; (iii) backcross only
C (i) testcross only; (ii) backcross only; (iii) both a testcross and a backcross
D (i) both a testcross and a backcross; (ii) backcross only; (iii) testcross only

Answer 749: C key only
No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Hard

750. Why can a carrier (Dd) not be recognised by its appearance?

A Carriers have no recessive allele in any of their cells
B Recessive alleles occur only in gametes, never in body cells
C The dominant allele masks the recessive, so Dd looks like DD
D The Dd phenotype is intermediate and cannot be classified

Answer 750: C key only
No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Devil

751. A tall plant of unknown genotype is testcrossed and all 30 offspring are tall. What is the most reasonable conclusion?

A The parent is very likely DD; a Dd parent would rarely give 30 tall
B The parent is certainly DD, since chance cannot affect 30 offspring
C The parent is Dd, since all offspring show the dominant trait
D The parent is dd, since the tester it was crossed with was recessive

Answer 751: A key only
No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Hard

752. Why is a homozygous recessive plant used as the tester parent in a testcross?

A It always gives tall offspring, whatever the other parent is
B It forces the unknown parent to self-fertilize before crossing
C It changes the alleles of the unknown parent during the cross
D It makes only d gametes, so offspring reveal the other parent's gametes

Answer 752: D key only
No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Medium

753. In the cross of round, yellow seeds with wrinkled, green seeds, all the F1 had round, yellow seeds. What does this show?

A The wrinkled and green alleles are lost in the F1

B Round and yellow are recessive to wrinkled and green

C Round and yellow are dominant over wrinkled and green

D The two genes are always inherited together as a unit

> **Answer 753: C** key only
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

754. From 556 F2 seeds the numbers were 315 round yellow, 108 round green, 101 wrinkled yellow and 32 wrinkled green. Which ratio do these closely fit?

A 3:1

B 9:3:3:1

C 1:1:1:1

D 1:2:1

> **Answer 754: B** key only
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

755. If the 556 F2 seeds follow a 9:3:3:1 ratio exactly, about how many should be round and yellow?

A About 313

B About 417

C About 104

D About 35

> **Answer 755: A** key only
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

756. How does the product rule explain the 9:3:3:1 ratio?

A It adds two 3:1 ratios together to give a 6:2 ratio

B It assumes the F1 produces only two kinds of gamete

C It assumes the two genes are always inherited together

D It treats the cross as two independent 3:1 crosses, $(3:1)^2$

> **Answer 756: D** key only
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

757. Assertion: A GgWw F1 plant produces four types of gamete in equal numbers. Reason: Members of different pairs of alleles assort independently into gametes.

A Both the assertion and the reason are true, and the reason is the correct explanation of the assertion.

B Both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.

C The assertion is true, but the reason is false.

D The assertion is false, but the reason is true.

> **Answer 757: A** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Devil

758. A GgWw plant is testcrossed. The offspring are round yellow 24, round green 26, wrinkled yellow 25 and wrinkled green 25. Which interpretation is best?

A The two genes are tightly linked on one chromosome

B Round and yellow are recessive traits in this plant

C The plant was homozygous for both of the genes

D The F1 made four gamete types in about equal numbers

> **Answer 758: D** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Devil

759. Round, yellow (GGWW) plants are crossed with wrinkled, green (ggww) plants. Which two F2 phenotypes are new combinations not seen in either parent?

A Round, green and wrinkled, yellow

B Round, yellow and wrinkled, green

C Round, yellow and round, green

D Wrinkled, yellow and wrinkled, green

> **Answer 759: A** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Devil

760. A cross gives offspring in a 9:3:3:1 ratio but the parental genotypes are unknown. What can the geneticist postulate?

A A single gene pair showing incomplete dominance in the F1

B Two independent pairs of alleles, one member of each acting as dominant

C Two linked genes that are always inherited together as one

D A single gene with four different alleles in the population

> **Answer 760: B** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Easy

761. An individual is heterozygous for n independent gene pairs. How many kinds of gametes can it produce?

A 3^n

B 2n

C 2^n

D n^2

> **Answer 761: C** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Medium

762. How many kinds of gametes can a DdGgWw plant produce?

A 8

B 6

C 9

D 27

> **Answer 762: A** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Medium

763. What is the F1 genotype of the cross DDGGWW × ddggww?

A DDGGWW

B DdGgWw

C ddggww

D DdGgWW

> **Answer 763: B** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Medium

764. Why is the forked-line method preferred for a trihybrid F1 × F1 cross?

A The forked-line method works only when the genes are linked

B The forked-line method changes the ratio to a 9:3:3:1 pattern

C A Punnett square cannot be used at all for a trihybrid cross

D A Punnett square needs 64 squares; forked-line combines three simple crosses

> **Answer 764: D** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

765. If one member of each pair is dominant, what phenotypic ratio is expected from DdGgWw × DdGgWw?

A 9:3:3:1

B 3:1

C 27:9:9:9:3:3:3:1

D 1:1:1:1:1:1:1:1

> **Answer 765: C** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

766. Using the forked-line method, what fraction of DdGgWw × DdGgWw offspring show the dominant phenotype for all three traits?

A 27/64

B 9/16

C 3/8

D 1/4

> **Answer 766: A** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

767. What fraction of DdGgWw × DdGgWw offspring show the recessive phenotype for all three traits?

A 1/8

B 1/64

C 1/16

D 1/4

> **Answer 767: B** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

768. What fraction of DdGgWw × DdGgWw offspring have the genotype DdGgWw?

A 1/64

B 1/4

C 1/8

D 27/64

> **Answer 768: C** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

769. A plant heterozygous for four independent gene pairs is self-fertilized. How many F2 genotypes and phenotypes are expected, with dominance at each?

A 16 genotypes and 81 phenotypes

B 64 genotypes and 16 phenotypes

C 81 genotypes and 81 phenotypes

D 81 genotypes and 16 phenotypes

> **Answer 769: D** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

770. Assertion: The number of F2 genotypes from n heterozygous gene pairs is 3^n.
Reason: Each heterozygous pair gives three genotypes in the F2, and independent pairs combine by multiplication.

A Both the assertion and the reason are true, and the reason is the correct explanation of the assertion.

B Both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.

C The assertion is true, but the reason is false.

D The assertion is false, but the reason is true.

> **Answer 770: A** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

771. For n independent heterozygous gene pairs with dominance, which statements are correct?
1. The number of gamete types is 2^n.
2. The number of F2 genotypes is 3^n.
3. The number of F2 phenotypes is 3^n.

A 1 and 3 only

B 2 and 3 only

C 1, 2 and 3

D 1 and 2 only

> **Answer 771: D** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Devil

772. How many gamete types and F2 genotypes can come from selfing an AaBbCCDd plant, with all gene pairs independent?

A 16 gamete types and 81 F2 genotypes

B 8 gamete types and 27 F2 genotypes

C 8 gamete types and 81 F2 genotypes

D 4 gamete types and 27 F2 genotypes

Answer 772: B key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Devil

773. In the testcross DdGgWw × ddggww, how many phenotypic classes are expected and in what proportions?

A Eight classes, each 1/8 of the offspring

B Eight classes in a 27:9:9:9:3:3:3:1 ratio

C Four classes, each 1/4 of the offspring

D Two classes in a 3:1 ratio of offspring

Answer 773: A key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Devil

774. A plant heterozygous for five independent gene pairs is testcrossed. How many phenotypic classes appear, and how are they distributed?

A 25 classes in equal proportions

B 32 classes in a 9:3:3:1-based ratio

C 32 classes in equal proportions

D 10 classes in equal proportions

Answer 774: C key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Devil

775. Assertion: A dihybrid F2 contains nine different genotypes.
Reason: A dihybrid F2 contains four different phenotypes when dominance is present.

A Both the assertion and the reason are true, and the reason is the correct explanation of the assertion.

B Both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.

C The assertion is true, but the reason is false.

D The assertion is false, but the reason is true.

Answer 775: B key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Devil

776. Assertion: A Punnett square for DdGgWw × DdGgWw needs 64 squares.
Reason: Each DdGgWw parent produces four kinds of gamete.

A Both the assertion and the reason are true, and the reason is the correct explanation of the assertion.

B Both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.

C The assertion is true, but the reason is false.

D The assertion is false, but the reason is true.

> **Answer 776: C** key only
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Devil

777. Assertion: A dihybrid backcross to the full recessive parent gives a 9:3:3:1 ratio.
Reason: The F1 produces four kinds of gamete in equal numbers.

A Both the assertion and the reason are true, and the reason is the correct explanation of the assertion.

B Both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.

C The assertion is true, but the reason is false.

D The assertion is false, but the reason is true.

> **Answer 777: D** key only
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Medium

778. Which formula is used in chi-square analysis?

A $\chi^2 = \Sigma(o - e)/e$

B $\chi^2 = \Sigma(o + e)^2/e$

C $\chi^2 = \Sigma(o - e)^2 \times e$

D $\chi^2 = \Sigma(o - e)^2/e$

> **Answer 778: D** key only
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

779. In a 3:1 test with 1000 offspring, the observed counts are 740 dominant and 260 recessive. What is the chi-square contribution of the dominant class?

A About 0.40

B About 0.53

C About 1.33

D About 0.13

> **Answer 779: D** key only
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

780. For the same data (740 dominant, 260 recessive; expected 750 and 250), what is the total chi-square value?

A About 0.53

B About 0.26

C About 1.06

D About 0.13

> **Answer 780: A** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Medium

781. Why is the degrees of freedom 1 for a 3:1 ratio but 3 for a 9:3:3:1 ratio?

A Degrees of freedom equal the number of offspring minus one

B Degrees of freedom equal the categories minus one: 2 − 1 and 4 − 1

C Degrees of freedom equal the largest number in the ratio

D Degrees of freedom equal the number of genes in the cross

> **Answer 781: B** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

782. A cross is expected to give a 3:1 ratio. Among 200 offspring, 152 are dominant and 48 are recessive. What is the chi-square value?

A About 0.04

B About 1.07

C About 0.11

D About 4.00

> **Answer 782: C** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Devil

783. A dihybrid cross of 160 offspring gives 96 : 28 : 26 : 10 for the four phenotypes. Tested against 9:3:3:1, what are the chi-square value and degrees of freedom?

A About 1.07 with 1 degree of freedom

B About 56 with 3 degrees of freedom

C About 1.07 with 3 degrees of freedom

D About 0.27 with 4 degrees of freedom

> **Answer 783: C** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Devil

784. Two experiments are tested against a 3:1 hypothesis. In A, 20 progeny give 12 dominant and 8 recessive. In B, 2000 progeny give 1200 dominant and 800 recessive. Which statement is correct?

A Both give the same chi-square, because the percentage split is the same in each

B A has the larger chi-square, because it has fewer offspring in total

C Neither can be tested, because a 3:1 test needs exact counts of offspring

D B has a far larger chi-square: the same split is less likely by chance in a large sample

> **Answer 784: D** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

785. Assertion: Tossing four coins can give all heads, but 1000 tosses practically cannot. Reason: The smaller the sample, the greater the impact of chance deviation.

A Both the assertion and the reason are true, and the reason is the correct explanation of the assertion.

B Both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.

C The assertion is true, but the reason is false.

D The assertion is false, but the reason is true.

> **Answer 785: A** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Medium

786. What does a chi-square goodness-of-fit test tell a geneticist?

A How well observed results fit an expected ratio, allowing for chance

B Which allele of a gene is dominant over the other alleles

C How many separate genes control the trait being studied

D The exact genotype of each individual offspring in the cross

> **Answer 786: A** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Easy

787. By convention, what P value is the standard cutoff for acceptable goodness of fit?

A 0.50

B 0.05

C 0.10

D 0.01

> **Answer 787: B** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Easy

788. In the formula $\chi^2 = \Sigma(o - e)^2/e$, what does "o" stand for?

A The observed count for a category

B The odds ratio of the two classes

C The original sample size of the cross

D The overall probability of the outcome

> **Answer 788: A** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Medium

789. Which of the following is NOT one of the four assumptions behind Mendel's 3:1 and 9:3:3:1 ratios as listed in the lecture?

A Dominance and recessiveness of alleles

B Segregation of the paired alleles

C Linkage between the two genes

D Random fertilization of the gametes

> **Answer 789: C** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

790. A dihybrid cross test gives P = 0.26. Which interpretation is correct?

A There is a 74% probability that the hypothesis is true

B About a 26% chance that a deviation this large arose by chance

C 26% of the offspring deviated from the expected ratio

D The data are unacceptable because 0.26 is far from 1

> **Answer 790: B** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

791. A chi-square test of a 9:3:3:1 hypothesis gives P = 0.04. What is the correct decision?

A Accept the ratio, because P is close to zero

B Accept the ratio, because the sample is large

C Reject the ratio, because P is above 0.05

D Reject the hypothesised ratio, because P is below 0.05

> **Answer 791: D** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

792. Which statements about P values in chi-square analysis are correct?
1. By convention, 0.05 is the cutoff.
2. A P value below 0.05 means the data do not fit the hypothesised ratio.
3. A P value above 0.05 proves the hypothesis is true.

A 1, 2 and 3
B 1 and 3 only
C 1 and 2 only
D 2 and 3 only

> **Answer 792: C** key only
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

793. In the dihybrid example, the four class contributions are 0.71, 0.34, 2.36 and 0.77. What is the total chi-square value?

A 4.81
B 3.41
C 4.18
D 1.05

> **Answer 793: C** key only
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

794. Why is each deviation (o − e) squared in the chi-square formula?

A So positive and negative deviations cannot cancel and big ones weigh more
B To convert each deviation directly into a probability value
C Because squaring is needed only when the sample is below 100
D To make the degrees of freedom equal to one in every case

> **Answer 794: A** key only
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Devil

795. Assertion: A P value of 0.26 proves that the 9:3:3:1 hypothesis is true.
Reason: P values between 0.05 and 1.0 are considered acceptable in chi-square analysis.

A Both the assertion and the reason are true, and the reason is the correct explanation of the assertion.
B Both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.
C The assertion is true, but the reason is false.
D The assertion is false, but the reason is true.

Answer 795: D key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Devil

796. Experiment 1 gives 740 dominant : 260 recessive against a 3:1 hypothesis ($\chi^2 \approx 0.53$). Experiment 2 has ten times the offspring with the same percentage split (7400 : 2600). What happens?

A χ^2 stays at about 0.53, so the 3:1 hypothesis is accepted

B χ^2 rises to about 5.3, P falls below 0.05, and the 3:1 ratio is rejected

C χ^2 falls to about 0.05, so the 3:1 hypothesis is accepted

D χ^2 rises to about 5.3, yet the 3:1 hypothesis is still accepted

Answer 796: B key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Devil

797. A student tests a 9:3:3:1 hypothesis but uses 1 degree of freedom instead of 3. For the same χ^2, how does the P value compare with the correct one?

A It is larger, so a poorly fitting hypothesis might be accepted

B It is identical, because degrees of freedom do not affect P

C It is exactly zero, whatever the chi-square value is

D It is smaller, risking rejection of a hypothesis that actually fits

Answer 797: D key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Devil

798. Decide whether each result is acceptable for goodness of fit.
(i) P = 0.60
(ii) P = 0.03
(iii) P = 0.12

A (i) unacceptable; (ii) acceptable; (iii) unacceptable

B (i) acceptable; (ii) acceptable; (iii) unacceptable

C (i) unacceptable; (ii) unacceptable; (iii) acceptable

D (i) acceptable; (ii) unacceptable; (iii) acceptable

Answer 798: D key only

No explanation — this paper is graded straight from the official answer key.

Practice Paper · Full paper · Hard

799. In the dihybrid example (expected 563, 187, 187, 63; observed 583, 195, 166, 56), which class contributes most to the chi-square value?

A The 9/16 class with 583 observed

B The 3/16 class with 166 observed

C The 3/16 class with 195 observed

D The 1/16 class with 56 observed

> **Answer 799: B** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

800. Which statement best matches the lecture's conclusion about heredity?

A Parents pass on DNA instructions that, with the environment, direct development

B Parents transmit a ready-made miniature version of the offspring

C Parents transmit acquired characteristics through gemmules in the blood

D Offspring development is determined by the environment alone, not by genes

> **Answer 800: A** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

801. Mendel's F2 of 787 tall and 277 dwarf plants gives 2.84:1, not exactly 3:1. What is the best explanation?

A Dwarf is partly dominant over tall in the heterozygote

B Segregation failed to occur in some of the plants

C The tall allele is actually recessive to dwarf

D Chance deviation, which is expected in a finite sample

> **Answer 801: D** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Medium

802. In Mendel's tall × dwarf cross, which statement uses the lecture's terms correctly?

A Tall is the character; height is one trait of it

B Height and tall are both alleles of the same gene

C Height is the character; tall is one trait of it

D Height is the genotype; tall is the gene's locus

> **Answer 802: C** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Medium

803. What does a dihybrid cross consider?

A One trait followed through two generations

B Two plants that share the same genotype

C Two traits followed at the same time

D Three alleles of a single gene at once

> **Answer 803: C** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

804. Which gametes can the F1 (GgWw) of a GGWW × ggww cross produce?

A GW, Gw, gW and gw

B GW and gw only

C Gg and Ww only

D GGWW and ggww

> **Answer 804: A** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

805. In the testcross DdGgWw × ddggww, how many kinds of gametes does each parent produce?

A Four kinds from each of the two parents

B Eight kinds from each of the two parents

C One from the F1 and eight from the recessive parent

D Eight from the F1, one from the recessive

> **Answer 805: D** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Devil

806. A dihybrid F1 (GgWw) is self-fertilized and gives 320 F2 seeds. How many are expected to be heterozygous for both genes (GgWw)?

A 180

B 80

C 20

D 160

> **Answer 806: B** key only
>
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Devil

807. Among the F2 seeds that are round and yellow from GgWw × GgWw, what fraction is GgWw?

A 4/9
B 1/4
C 9/16
D 1/2

> **Answer 807: A** key only
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Devil

808. Two double heterozygotes are crossed and give mostly parental types with few new combinations, instead of 9:3:3:1. Which explanation is best?

A Dominance is absent at both of the gene loci in the cross
B Segregation did not occur in either of the parents' gametes
C The sample of offspring was far too large to be reliable
D They may not assort independently, e.g. if linked on one chromosome

> **Answer 808: D** key only
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Hard

809. Which idea did the germplasm theory seriously challenge, and who proposed it?

A Epigenesis, challenged by August Weismann
B Pangenesis, challenged by August Weismann
C Pangenesis, challenged by Charles Darwin
D Preformation, challenged by Charles Darwin

> **Answer 809: B** key only
> *No explanation — this paper is graded straight from the official answer key.*

Practice Paper · Full paper · Devil

810. In a DdGgWw × DdGgWw cross, what is the probability that an offspring shows the dominant phenotype for traits D and G but the recessive phenotype for trait W?

A 27/64
B 3/64
C 9/64
D 1/64

> **Answer 810: C** key only
> *No explanation — this paper is graded straight from the official answer key.*